SCIENTIFIC AMERICAN

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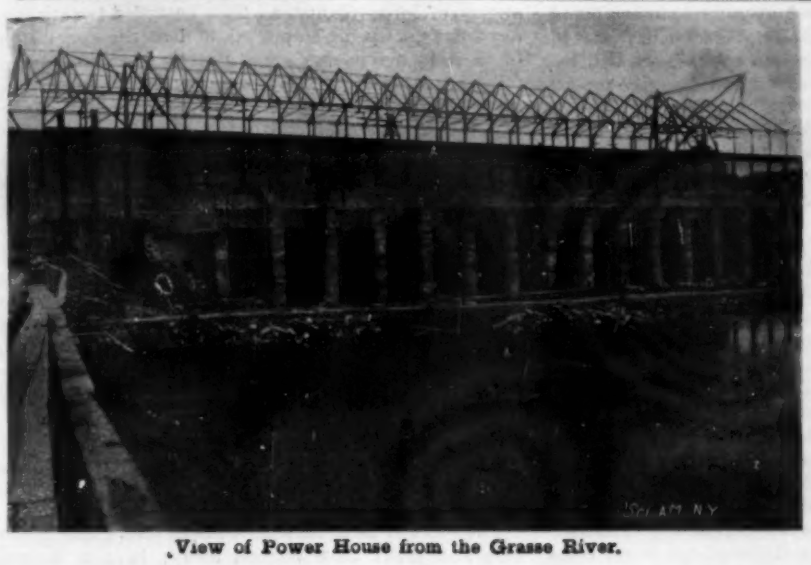
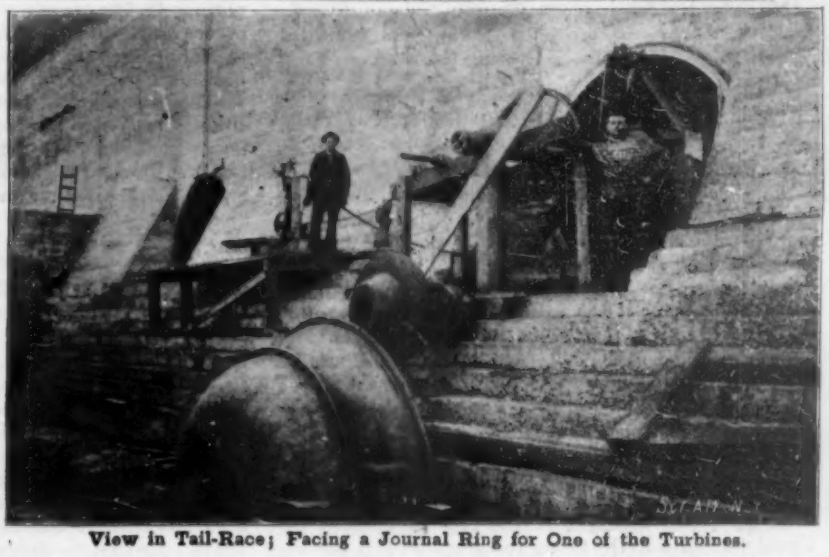


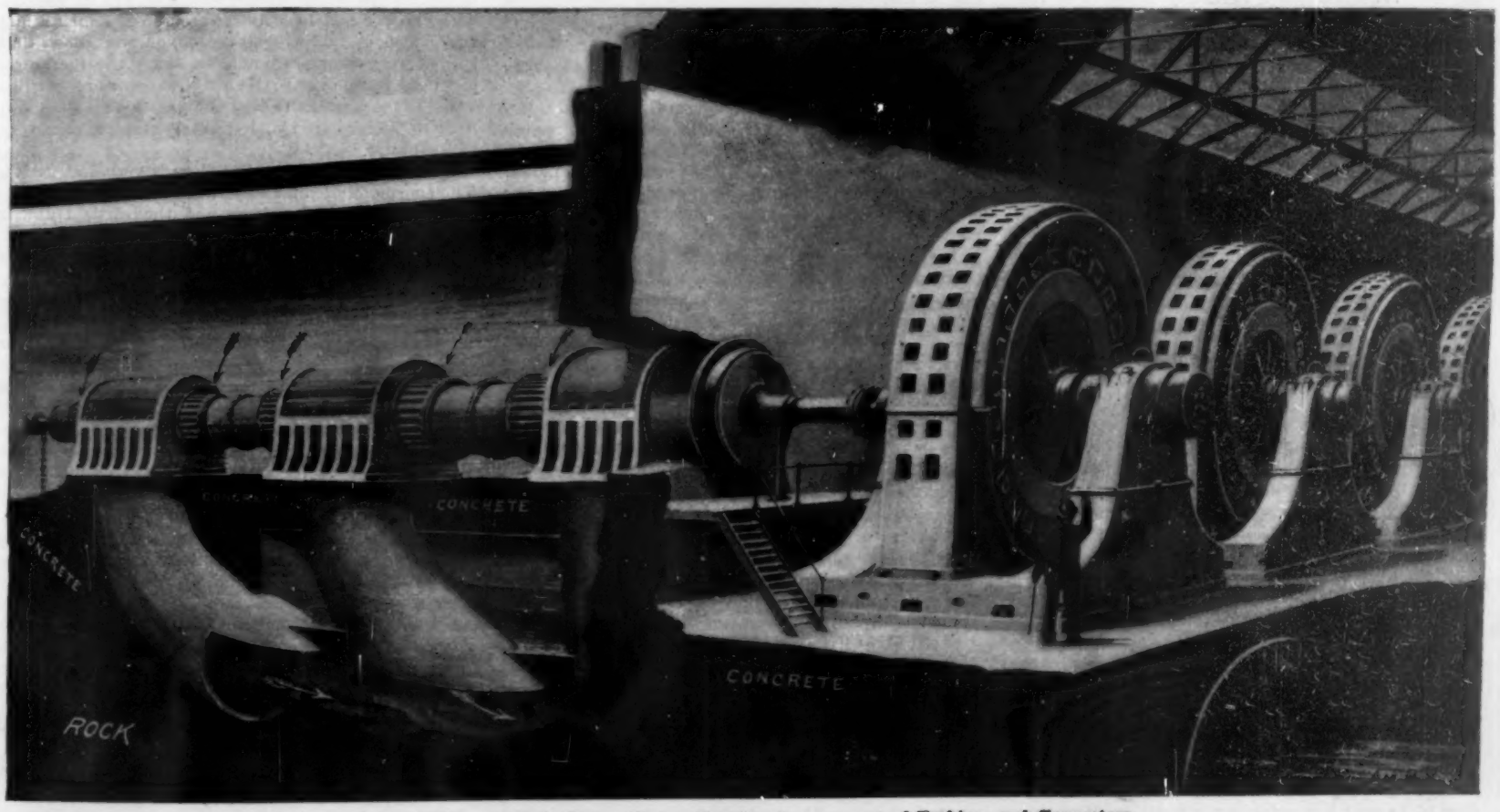
View of Power House from the Grasse River.



View in Tail-Race; Facing a Journal Ring for One of the Turbines.

Partially Completed Canal (August 1) at Entrance from St. Lawrence River.

Large Hydraulic Dredge at Work, Showing Floating Discharge Pipe.



Sectional View through Power House, Showing Arrangement of Turbines and Generators.

THE NEW 75,000 HORSE POWER PLANT AT MASSENA, NEW YORK.—[See page 310.]

Scientific American.

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NEW YORK, SATURDAY, NOVEMBER 17, 1900.

WANTED—A MARINE ENGINE GOVERNOR.

The accident to the engines of the "St. Paul" calls to mind the more serious disaster which several years ago overtook the "City of Paris," when she was running in the service of the Inman and International Line. There is this difference, among others, between the two engine room wrecks, that while the predisposing cause in the case of the "St. Paul" is said to be well known, in the case of the "City of Paris" it will always remain a matter of doubt. It is supposed that the propeller shaft of the "City of Paris" gave way, and that the consequent racing of the engines caused the most extraordinary smash-up of cylinders, bed-plates, and reciprocating parts which ensued. According to the published reports of the officers of the ship, the wrecking of the engines of the "St. Paul" was due to the loss of the propeller and parting of the shaft as the result of an encounter with a derelict. If the propeller did not strike a submerged wreck, it is quite possible that, as the ship is reported to have been driving into a head sea, the sudden submersion of the propellers, when the engines were racing, may have set up sufficient strain to cause the fracture of the shaft. In any case, whatever was the predisposing cause, the immediate occasion of the wrecking of the engines, both in the "Paris" and the "St. Paul," was undoubtedly the running away of the engines, due to the sudden removal of the load.

The recent accident serves to emphasize once more the crying need that exists for the introduction of a marine engine governor that will govern: some device which will not merely act when the propeller is lifted clear of the water, but which will immediately check the speed when, by the total loss of the propeller or the parting of the shaft, the load is entirely and permanently removed. We believe that it is the common consent of steamship men that a perfectly satisfactory governor of this kind has yet to be designed. We say this with a full knowledge of the fact that some very ingenious governing devices have been tried and are being tried, and that as far as they go some of them are doing very good work. The trouble with most marine governors is that they fail to act with that anticipatory effect which is necessary properly to control any form of marine engine, and doubly necessary to govern the modern multi-cylindered engines of the triple and quadruple expansion type.

In the days of the simple high pressure or of the single-expansion condensing engine, the common form of centrifugal governor, acting on the throttle, was fairly effective. Steam was cut off the instant that the engine commenced to race, and beyond any temporary acceleration, no excessive and prolonged racing was possible; but with the introduction of triple, and, later, of quadruple-expansion engines, the problem has been greatly complicated; for even if the supply of steam is cut off from the high-pressure cylinders at the first instant of racing, there are still, in the case say of a six-cylinder engine, four large cylinders full of steam which are free to exert their power on the shaft, and it will take three or four revolutions before this steam has passed through the engine and been condensed at the condenser. Evidently a marine governor to be effective must anticipate, by three or four revolutions of the engines, the moment when the propellers will be lifted from the water. It has been the object of some cleverly designed governors to secure this action. One of the best known of these consists of a well opening through the floor of the vessel and located some distance from the stern, in which the water rises to the same level as the water on the outside of the hull at that particular part of the vessel. Within the well is a float which acts through suitable mechanism upon the throttle valve; and the theory of the device is that as the trough of the wave passes aft, and before it reaches the propeller, the sinking of the water in the well will cause the steam to be throttled a few moments before the trough of the waves reaches the propellers. By this device it is sought to empty all the cylinders of the engine before the load is removed from the propellers. Another form which has met with some measure of success is a governor which acts directly on the reversing gear and throws the valve motion into the center, thus controlling all the cylinders of the engine at once.

The chief engineer of one of the fastest of the Atlantic liners recently informed us that although his engines are equipped with one of the best types of governor, he is so far distrustful of its efficiency that during a spell of heavy weather he guards against disaster by letting the steam run down considerably in the boilers. While this precaution is a wise one, it is after all but a compromise. The fact of the matter is that with the extraordinary increase in the weight and horsepower of marine engines which is now taking place, the governor problem assumes increasing importance. The captain who finds himself in command of a big ship with an extraordinary reserve of power in its engine room is tempted to make use of it and drive his ship at full pressure in heavy weather, and we shall see more of this as the time goes by and the competition for record passages grows keener. The demand for a device which will allow these engines to be driven to their maximum capacity against a head sea grows more pressing with every high-speed liner that is floated.

THE SEA ROUTE AS A COMPETITOR OF THE SIBERIAN RAILWAY.

There seems to be a decided division of opinion in the Russian press as to the part which the Trans-Siberian Railway is to play in the carriage of freight between Europe and Asia. The optimistic press believes that the scheme will attract to itself a large portion of the freight which is now carried by sea between European and Asiatic ports. On the other hand, we find the Novosti declaring that all hopes of any considerable revenue accruing to the road from this source are based upon a misunderstanding of the situation. It contends that the Siberian Railroad can never compete successfully, either in point of time or cost, with ocean-going steamers, for the reason that it takes forty-two days to carry freight from Irkutsk to Moscow by rail, and that the steamers are making the same rate of speed at the present day. The question of time, however, is not so serious as is that of the cost of transportation, and the Novosti claims that in this respect also the railroad will find itself to be at a serious disadvantage. Thus, it is assumed that if the carriage of freight between Hamburg and Port Arthur, a distance of 6,000 miles, costs only about one-two hundredth part of a cent per pood of thirty-six pounds per verst of two-thirds of a mile, then the freight per pood between these two ports will amount to forty-five cents. As against this rate by rail it seems that the rate by sea from Hamburg to Vladivostock is only eighteen cents per pood of thirty-six pounds. It is claimed that although this difference between the rail and sea rates is so great, the steamers are carrying freight at a fair profit, while the Siberian road is carrying freight at less than cost, even when making the higher charge of forty-five cents as mentioned above. From this comparison it is concluded that for the present, at least, the railroad cannot figure as a competitor with the steamers which are already engaged in the trade. The field for the activity of the railroad lies in the direction of developing the more or less local traffic, and in promoting the settlement of the country and upbuilding its industries.

CALIFORNIA'S BIG TREES.

The Forester of the Department of Agriculture, Mr. Gifford Pinchot, has just written a most interesting account of the "Big Trees" of California, and the dangers which menace them. Before the glacial period the genus called Sequoia flourished widely in the temperate zones of three continents. There were many species, and Europe, Asia, and America had each its share. But when the ice fields moved down out of the North, the luxuriant vegetation of the age declined, and with it the multitude of trees. One after another the different kinds gave way, their remains became buried, and when the ice receded just two species, the Big Tree and the Redwood, survived. Both grow in California, each in a separate locality, the Redwood occupying a narrow strip of the coast ranges ten to thirty miles wide and extending from Oregon to the Bay of Monterey. The Big Tree (Sequoia Washingtoniana) is found in small groves scattered along the west slope of the Sierra Nevada Mountains. There are ten main groves or groups of trees, and the number of specimens figures up some thousands, but only about 500 are remarkable for their size.

The Big Trees are unique; they are the oldest living thing, and are the most majestic of trees, and are extremely interesting from a scientific point of view as being the best living examples of a former geologic age. Their vitality is remarkable, the fungus is an enemy unknown to it, and the best specimens have been found to be sound at heart when felled. These great natural curiosities have only been able to hold their own by reason of favorable climatic conditions. The Mariposa grove is the only one which may be said to be entirely safe, and most of the other groves are being destroyed. The finest of all, Calaveras Grove, which has the tallest trees, has been bought by a lumberman. The Sequoia and General Grant National Parks are eaten into by private claims. In brief, the majority of the trees are owned by men who have the right, and in most cases the intention, to fell them.

The Calaveras Grove was discovered in 1841 by John Bidwell, and by 1870 the majority of the big trees had been located. One of the largest examples in the Calaveras Grove was cut down in 1853; the bark was 15 to 18 inches in thickness, and after stripping this off, the diameter of the trunk was found to be 25 feet at a height of 6 feet above the ground; it was 302 feet high. It was found to be impossible to fell it by ordinary means, so the trunk was bored by pump augers of large diameter. This occupied twenty-two days, five men being employed, and at the conclusion of their labors it was found that the tree would not fall, so two and a half days were consumed in driving in wedges; the men then retired for dinner, and a gust of wind blew it over, Nature apparently wishing to prevent the hand of man from consummating this last act in a great tragedy of the forest. The bark was used to form a room in the old Crystal Palace, at South Kensington. A cotillon party of 32 persons danced on the stump. Another tree, called "The Mother of the Forest," was 321 feet high and 137 feet to the first branch. It is estimated that there were 537,000 feet of sound inch timber in the tree. The "Father of the Forest" was about 400 feet high when standing, and its circumference at its base was 110 feet. A number of the living trees have been named, and most of them are marked with marble tablets.

There are 1,380 Big Trees in the Stanislaus or South Calaveras Grove, including "Smith's Cabin," in the charred hollow of which a trapper lived for three years, and where he occasionally also stabled his horse.

The "Canal Boat" is a decumbent tree. The upper side and heart have burned away; in the bottom thousands of young big trees have started. In the Mariposa Grove is a tree through which a road has been cut.

Unfortunately, the Big Trees are exquisitely proportioned and are the noblest specimens which the botanical world can offer, and for this and by reason of their extreme age they ought to be protected from vandals. Many of the Big Trees are estimated to be 3,600 years old, and 4,000 rings have been counted. Under the most favorable conditions these giants probably live to be 5,000 years old, and even more. They seldom die natural deaths; they seem to be exempt from the diseases which afflict other trees. Their worst enemy is man, then comes fire, lightning, storms, and the giving way of the ground on which they stand.

Fossils show the Big Tree to be the remnant of a once numerous family; it is a direct or collateral descendant of ancient species. Their ancestors formed a large part of the forests which flourished throughout the Polar regions, now desolate and ice-clad, and which extended into the low latitudes of Europe. The natural reproduction of the tree is slow, and the preservation of the race is dependent on maintaining the present groves intact. The big tree rejoices in five names which have been given to it at various times; Sequoia, Washingtoniana, however, which was proposed in 1898, will probably be the name under which it will be known. The big tree has been introduced into England and the Continent, and while it has done well it shows that the existing climates do not suit it, and the Sierra forests need fear no rivals. It has been occasionally cultivated in the Eastern United States, where it does not flourish. There are two trees 35 feet high in a nursery at Rochester, N. Y.

The lumbering of the Big Tree is very destructive. The enormous size and weight of the tree naturally entails considerable breakage, and the brittle trunk is liable to be smashed by any inequalities in the ground. The loss from this cause is great, but it is only one of the sources of waste. The great diameter of the logs, notwithstanding the lightness of the wood, causes their weight to be so enormous that it is impossible to handle many of them without breaking them up. For this purpose gunpowder is used, and the fragments are often of wasteful shapes, and unless great care is used in preparing the blast, a great deal of the wood itself is scattered into useless splinters. At the mill, where waste is the rule in the manufacture of lumber in the United States, the big tree makes no exception. This waste added to the other sources of loss makes a total probably often considerably in excess of half the total volume of the tree. The big tree also stands as a rule in a mixed forest composed of many species, and the destruction caused by the fall of one of the enormous trees is in itself great, but the principal source of damage is the immense amount of debris left on the ground, a certain source of future fires. This mass of broken branches, trunks and bark is often 5 or 6 feet thick, and necessarily gives rise to fires of great destructive power, although the Big Tree wood is not specially inflammable. The devastation which follows such lumbering is as complete and deplorable as the untouched forest is unparalleled, beautiful and worthy of preservation. Fortunately, much of this appalling destruction has been done without leaving the owners of the Big Trees as well off as they were before it began.

HOME-MADE APPARATUS FROM HOME MATERIALS.

We commence in this issue the publication of a series of articles by George M. Hopkins, the well known author of Experimental Science, which is certain to interest a wide circle among our readers, many of whom doubtless are looking for such information and suggestions as the articles contain. Everyone, boy or man, with a touch of mechanical instinct is possessed at times with the desire to amuse himself by putting some of the simpler mechanical movements into the concrete shape of a steam engine, lathe, electric motor, tool, or what-not. In the case of most of us, the task is rendered difficult by the lack of proper materials or the necessary implements, which may often be beyond reach, either because the would-be mechanic lives in a village or country district, where such things are unprocurable, or because the cash to buy the necessary outfit is not available: the latter a frequent obstacle, we fear, to engineering schemes, where the engineer is yet on the roll-call of the district school and his pence are subject to a steady drain for candy, kites and fireworks.

In the series of articles referred to, the author shows by drawings and descriptions how, by the use of ready-to-hand material about the house, the amateur mechanic may construct useful working apparatus without "going off the block" or outside the village boundaries; and the reader will discover that it is wonderful how much a little ingenuity can accomplish with those odds and ends of metal work—the leavings of the plumber and the furnace man, discarded kitchen utensils or the wreck of a worn-out sewing machine—which would ordinarily find their way to the "ash-man" and the junkshop.

Particular value attaches to these articles from the fact that the illustrations are made from actual apparatus, constructed at different times either by the author or his assistant; and the reader who sets out to make one of these machines may rest satisfied that he is building a "working" model that will work.

ACTINO-ELECTRIC PHENOMENA PRODUCED BY VIOLET RAYS.*

BY BICHAT AND SWINGEDAUW.

The production of electric currents under the action of light has been known for some time, especially by the work of Ed. Becquerel. An experiment made by Hertz in 1887 was the starting point for a great number of researches which will be briefly described. During his experiments with electric oscillations he showed that the sparking distance between the two spheres of an exciter was increased simply by the fact that they were lighted by another spark or a source rich in violet rays. A short time after, M. Hallowachs showed the influence of the more refrangible rays upon the loss of charge of negative electricity. The latter phenomenon will be first considered. If a metal plate is united to an electroscope and illuminated by an arc lamp, the loss of charge is made evident. If the plate is negatively electrified, the gold leaves approach each other rapidly; if positively, no effect is produced. Messrs. Righi and Stoletow operate as follows: A metallic plate and a sheet of wire gauze are placed parallel at about one-eighth of an inch; M. Righi unites the two conductors to the two pairs of quadrants of an electrometer; M. Stoletow connects the metal plate to the negative pole of one hundred cells of battery and the gauze to the positive pole, with a sensitive galvanometer in the circuit. When the plate is lighted through the wire gauze, the galvanometer is deflected. When the connections are changed the effect is null. It is the violet or ultra-violet rays that have the greatest action, but with potassium the light of a candle and even the less refrangible rays give the effect. All the substances transparent for violet or ultra-violet rays let the active rays pass, but glass and mica cut off the greater part. If the negatively charged body is transparent for the active rays, such as water, the effect is less, while non-transparent liquids, as solutions of fuchsine, act like the metals.

M. Righi was the first to show the action of light upon non-electrified bodies, in 1888. If the plate and wire gauze which are united to the two pairs of quadrants of an electrometer with charged needle are of different metals, a deviation is obtained when the plate is illuminated through the gauze screen; the deflection is independent of the charge of the plate or the distance apart, but depends on the nature of the metals used. If the same metals are used, a deflection is obtained; this system constitutes a photo-electric couple. Such couples may be placed in series and are analogous to piles on open circuit. If the gauze is suppressed and an isolated body is lighted, it is electrified, but much more slowly. The maximum potential depends upon the nature of the metal; the electrification is positive in general, but is negative in some exceptional cases. Messrs. Elster and Geitel have shown that polarization of the light has a marked effect. In the case of a sodium-potassium amalgam upon whose surface the light of a lamp polarized by a Nicol's prism falls at an angle of 45°, the deviation of a galvanometer in circuit with it and a battery of 250 volts is a maximum when the plane of polarization and the plane of incidence are perpendicular, and vice versa, the relation between maxima and minima being as 1 to 10. As to the mechanism of the transport of electricity under the action of the rays, the question is not fully decided. M. Arrhenius, in 1887, supposed that the gas acquires a kind of electrolytic conductibility under the action of the rays; several other physicists had the same opinion. This idea has been disputed by others since that time, especially by M. Righi, who seems to have demonstrated that the discharge takes place by convection, with a speed of 150 to 750 feet per second. Other experiments seem to confirm this opinion, notably that of M. Ernst Simon, who shows that the change in the specific inductive capacity of the gases, which should be considerable if they became conductors, is in reality feeble. The nature of the particles is to be considered. Messrs. Lenard and Wolf have shown that under the action of the refrangible rays the surface layer of metals is disintegrated, and the particles taken from the surface may thus carry the charge. M. Righi, however, supposes that the gaseous molecules carry the charge. If the gases condensed at the surface are driven off by heating, the effect is much less. Other experiments seem to confirm this idea. M. Lenard has recently found that a metal plate in a vacuum, lighted by ultra-violet rays, emits rays charged negatively and deviable by the magnetic field like cathodic rays. These phenomena give an explanation of atmospheric electricity. It has been found by M. Buisson that ice, when dry, acts like a metal under these circumstances, but when wet the effect is null. On the other hand, the action of the ultra-violet rays increases when the pressure diminishes, and the atmosphere absorbs these radiations coming from the sun. According to M. Brillouin, the electrification of the atmosphere is due to the action of the solar light upon the ice-needles of the cirrus. These needles, lighted by the sun in air relatively rarefied, lose negative electricity and the surrounding air becomes negatively electrified without becoming conductor. This air yields its charge when in contact with the earth. Different observations seem to uphold this idea. It remains to be seen whether the phenomena of ultra-violet rays are connected with those of like nature due to flames, incandescent bodies, phosphorus, cathodic rays, etc. To connect these, it suffices to admit that in all cases there is emission of cathodic rays; a further study of the subject would be useful.

The second series of phenomena is the increase of the sparking distance. The action of the ultra-violet rays upon the spark was first discovered by Hertz. He showed the action of the rays from one spark upon another by arranging two sets of dischargers, one beside the other, both being connected with the same induction coil. One discharger was regulated at a small distance, and gave a spark at each interruption of the circuit; the second had the maximum distance at which such a spark passed. If now a metal or glass plate was placed between the two dischargers, the latter spark ceased, but reappeared upon removing the plate. It was found that the interposition of the plate diminished a two-inch-sparking distance to one inch. The action of the spark is propagated in straight lines, and the active rays are absorbed by most solids; quartz is transparent, also water, alcohol and ether. Melted paraffine, benzine, bisulphide of carbon, are almost opaque. The rays are reflected and refracted like light rays; a prism of quartz interposed will suppress the action by deflecting the rays; if the discharger is moved to the base of the prism, the action reappears. Different experiments show that it is the ultra-violet rays which produce the action. Ordinary sources, rich in these rays, give analogous results, the electric arc, for instance. It may be concluded, with Hertz, that ultra-violet light has the property of increasing the distance of disruptive discharge of an induction coil, or like discharges. The increase depends upon several factors: The form of the poles; it is greater with balls than with points. The nature and pressure of the gases; when the pressure is diminished, it passes toward a minimum. The nature of the poles; platinum is especially sensitive, copper and zinc are less so, and aluminium unsensitive. A meniscus of pure water is unsensitive, while that of an absorbent liquid is sensitive. Messrs. Wiedemann and Ebert, who made the experiments, consider that the increase augments with the absorbent power of bodies for the active rays. The surface of the poles must be acted upon, and not the intervening space; both poles are sensitive, according to Hertz, but Wiedemann and Ebert, with 0·12-inch poles, find the cathode alone sensible. The authors have shown that the sensitiveness of the positive pole depends upon its radius, being null for a diameter less than 0·2 inch, but then increases. The action is manifest in a time smaller than one-billionth of a second, as shown by M. Swingedauw. The action depends upon the condition of the charge; it is an increasing function of the rapidity of the variation of potential at the instant the spark occurs, as the latter experimenter shows. It seems, then, that the increase of sparking distance between two poles under the action of ultra-violet light depends upon the nature, form, and distance of the poles, the nature of the dielectric and the speed of variation of potential. In conclusion, it may be asked whether the phenomena of descriptive discharge and those of loss of charge provoked by ultra-violet rays are not correlative; certain experiments seem to favor this idea, but a systematic and exact study of the two actions is necessary.

* Abstract of lecture reported by the Paris correspondent of the SCIENTIFIC AMERICAN.

SCIENCE NOTES.

John D. Rockefeller has given $100,000 to the psychological laboratory at Columbia University.

Mt. St. Elias has been badly shaken by an earthquake. It is said that the mountain was considerably torn up. The shock was so severe that a mass of ice, acres in extent, broke loose from the top of the mountain, and went crashing down the sides carrying everything with it.

The New York Central and Hudson River Railroad is building a new passenger station at the Bedford Park entrance to the New York Botanical Garden. The passenger shelters and waiting rooms on the east side will open directly into the plaza, and the name of the station will be changed to Bronx Park.

A mountain-climbing party in the Sandwich Islands was attacked by a colony of wild bees. They had climbed Konahunui, the highest peak near Honolulu. In descending precipitous cliffs they were attacked by the bees, which stung them when they were helpless to ward off the insects. For nearly a mile the bees followed them until they reached a point where they could defend themselves.

A model of the cathedral of St. John the Divine has been under construction for the past two years. It will be a miniature building, 50 by 25 feet, with a height of 35 feet. It is on a scale of an inch to the foot. The structure will be built of plaster, and a wooden frame will accommodate over a hundred persons. It is to be exhibited on the site of the cathedral, and possibly inside of a temporary structure. The work upon the cathedral proceeds slowly.

Surgeon-General Van Reypen does not consider that Guam is a good naval station. He says that typhoid fever is practically endemic in the island, owing to the pollution of the drinking water. There have been twenty-five cases and four deaths from this cause in a force of 143 men. The climate is also debilitating, but is not otherwise bad. The mean annual temperature is above 77° Fah. The Surgeon-General considers it would be better to establish a station at Cabras Island, which, as it is not inhabited at present, has its soil free from infection.

A new life-saving net has been adopted by the New York Fire Department. It consists of a circular gas pipe frame, which shuts up like an old-fashioned purse, and which when opened has a diameter of 18 feet. A canvas net is attached to the frame, and the canvas is lined with a layer of wadding two inches thick. The shock to a person striking the net is reduced to a minimum, and the difficulty in holding it is lessened by means of strong springs by which the canvas is attached to the frame. They take up the force of the impact. A trial was recently held, and a fireman jumped from a height of four stories into the net, and the shock of the impact was trifling. The men who were holding the net felt practically no strain.

An American circus has been visiting Germany, and our consul at Aix-la-Chapelle gives an interesting account of the way the Germans received the show. The bill-posting was a revelation to them, both in magnitude and character. The way in which the tents were erected and the ground prepared astonished the people. When the circus itself arrived, not a workman went to the factories, and the spindles were idle all day. At every performance the tents were filled, and the vague antipathy against the United States has been turned into respect and awe. The people now consider that anything is possible to Americans. Our consul considers that if an agent of American goods would follow in the wake of the circus, he would make ready sales.

According to the national law of Italy, dated February 7, 1892, anybody who suppresses, destroys, sells, or in anyway turns to his own profit paintings, statues, or other works of art kept in galleries, libraries or private collections mentioned in the law of June 28, 1871, is liable to imprisonment and fine. Prince Chigi has just been tried for selling one of his own pictures, a Madonna and Child, by Botticelli. It was stated that a vast sum was paid the Prince for this picture. The Roman court fined him $63,000 and sentenced him to three months' imprisonment. In order to get the picture out of Italy, it is reported that another subject was painted over the picture. This completely mystified the customs officers, and the sale of the picture was not discovered until it was well out of the country. It is rumored that other pictures are in danger of being smuggled out of Italy, but the government is taking measures to promptly punish anyone making a sale of this kind.

THE WOODS ELECTRIC VEHICLES.

Among the exhibits at the automobile show are some interesting vehicles shown by the Woods Motor Vehicle Company, of Chicago and New York. This company has recently put upon the market a number of entirely new designs, and we illustrate two of them. The motor vehicle proposition is one which, in its broadest sense, involves in addition to public transportation the equipment and maintenance of hundreds of thousands of gentlemen's private stables with fine carriages in all variety of styles rather than the creation of a machine which will transport a man from town to town, or on long country tours, and this company has aimed to supply the wants of the former class. Electrical propulsion being clean and almost noiseless recommends itself specially for private conveyances. The carriages we show are an open electric landau and a country club wagon, both of which are useful and handsome vehicles. For many practical reasons the company has entirely abandoned the use of wire wheels, pneumatic tires and tubular construction, and are now confining themselves strictly to such carriage design and construction as is well known in the art, which makes them susceptible of repairs, so far as the carriage part is concerned, by any carriage manufacturer in the country, and the electrical parts have been so standardized and simplified that any electrician employed by an electric light company or plant in any city can successfully make any inspection and repairs that may be necessary from time to time, in all of which their object has been to provide resources independent of factory, by which the purchaser can give his vehicle proper care and attention in his own city or town. The moving parts are provided with ball bearings interchangeable in their details, and the entire construction of the vehicle is one in which efficiency and durability are alone considered. There are three or four speeds controlled by the same lever that applies the brake, so that only two points of attention are necessary for the entire management of the vehicle. They run backward or forward, and the removal of key from the reversing switch locks the vehicles when not in use. Their running capacity is 50 to 75 miles per day, subject to recharging facilities or duplication of the batteries.

COUNTRY CLUB WAGON.

ELECTRIC LANDAU OPEN.

The Selenides of Nickel.

M. Fouzes-Diacon, who has lately made a number of interesting researches, has succeeded in forming a series of new compounds, namely, the selenides of nickel. The experimenter describes his method in a paper recently presented to the Académie des Sciences. The only previous work in this direction is that of Little, who found that the vapor of selenium reacts, at a red heat, upon powdered nickel, giving a crystalline mass appearing to consist of crystals of the cubic system. The series of selenium compounds prepared by M. Fouzes-Diacon is quite extensive, and is analogous to the corresponding sulphides; among others he has obtained the protoselenide of nickel in well marked cubical crystals. It is prepared by bringing the selenium vapor, very diluted in a current of nitrogen, upon plates of nickel brought to a red heat. The plates are seen to become covered with crystals having the appearance of moss or of long prisms. If the selenium vapor brought by the nitrogen arrives in greater proportion, the nickel plates become covered with crystals which are much more distinct, resulting from the fusion of the first crystals formed. If the operation is stopped at this moment, to avoid the complete fusion of the crystalline layer, this is seen to be formed mainly of double tetrahedrons, right and left combined. The crystals are very distinct, having a gray color with bluish reflections and corresponding to the formula, Ni Se. The protoselenide of nickel thus appears to belong to the cubic system.

To obtain the sesquiselenide, the anhydrous chloride of nickel is heated to redness in a current of hydrogen selenide; it gives rise to products corresponding, according to circumstances, to $Ni_3 Se_2$ or $Ni_2 Se_3$. A gray crystalline product was especially obtained, which presented forms derived from the cubic system, whose formula approaches $Ni_3 Se_4$, but is not quite free from a product less rich in selenium. The biselenide of nickel, corresponding to the formula $Ni Se_2$, is obtained by the reaction of hydrogen selenide upon anhydrous chloride of nickel, heated to a temperature of about 300° C. It has the appearance of a friable mass of a dull grayish black. The same result is obtained by using nickel oxide. The preceding compounds, heated to whiteness in a current of hydrogen, lose selenium by degrees, and there results a melted mass of a yellow bronze color with a metallic fracture. This product, powdered and submitted again at a high temperature to the action of hydrogen during six or eight hours, is transformed into a sub-selenide of nickel, $Ni_2 Se$, having the appearance of melted masses of a golden yellow. The oxyselenide of nickel has also been obtained. The experimenter wished to form the sub-selenide, analogous to the sub-sulphide which has been prepared by Arfoedson by reducing the sulphate in a current of hydrogen. The seleniate of nickel previously dried was accordingly heated in a current of dry hydrogen; in the beginning water vapor is formed with sublimation of selenious anhydride, as the temperature rises, the hydrogen reacts upon the salt with incandescence. The operation is then stopped, and a dark green powder is found, which dissolves partly in dilute hydrochloric acid without disengagement of gas, and entirely in the concentrated acid, giving off hydrogen selenide. This body proves to be an oxyselenide of nickel, or rather a mixture of oxide and selenide of nickel, whose proportions vary according to the rapidity with which the reducing temperature has been obtained. The properties of the selenides of nickel have been studied by the experimenter. Hydrochloric acid, even concentrated, attacks them but slightly; in the gaseous form it transforms them at a high temperature to nickel chloride. Nitric acid oxidizes them and forms selenites; chlorine displaces the selenium at a moderately high temperature. When heated in a current of oxygen, they give the green nickel oxide and selenious anhydride.

The Ruins of Eridu, 2400 B. C.

About the mound is a wall some 20 feet in height, pierced by three openings, the remains of the gateways, says Biblia. Nearly the entire inclosure is filled with a brick platform, equal in height with the surrounding wall. The southern part of the mound contains a few imposing ruins, but on the northern edge stands the temple, a pyramidal-shaped building, reaching 70 feet above the platform. Two of its stories are still to be seen. A peculiar feature of the temple is a marble stairway 15 feet broad and 70 feet in length, leading up to the exterior. The polished marble slabs which served as steps are still scattered among the ruins, attesting to the extreme richness of the building, and along the two edges of the stairway are balustrades; at the foot of the stairway the bases of two large pillars remain, the object of which is uncertain. The peculiar shape of the bricks, plain cones, cylinders, innumerable fragments of pottery, pure gold leaf, and stone implements abounding in great profusion, are the distinguishing features of this ruin. Unlike most other Babylonian temples, that at Eridu was built partly of stone, for the architects here had access to the neighboring sandstone ridges, and the plain to the south abounds in great boulders of black granite. The statement frequently made that the huge stones from which the Telloh statues were hewn were quarried at Sinai must now be modified, for the quarries about Eridu supplied the material. Mr. Taylor, speaking of the mound, says that as one approaches it he will see "blocks and pieces of marble, rough and polished, of different colors of the most beautiful hues; fragments of bowls, vases and coffins, in crystal, marble, and alabaster; gilt-headed nails, curious bricks, and tiles of original shape and composition, and lastly, and the most curious and interesting, the clay hatchets and hammers, the flint knives and styles, stone and clay nails, and a hundred other objects so palpably denoting a remote period and one of the earliest stages of civilization." One may imagine the desire which the excavator has to reveal the treasures buried in this ruin.

Another Railway in China.

The Russian government in China is contemplating the construction of another railway in China. The course of the new line, as at present projected, will run from Samarkand to Hankow, via Chodschend, Margitan, and through one of the Pamirs. Should this route be ultimately followed, it will involve the boring of a tunnel through the Koshgor Mountains. Koshgor is the center of the transit trade between Russian Central Asia and East Turkestan, and the new overland route will either run to Chatan, thence to Tschortschen, and Tschorjolyk at the Lobnor Lake, or it will traverse the Tarim Valley. From the Lobnor Lake the line will stretch through one of the passes in the Altyn Mountains to the Tsoidam Plateau, thence along the Semenow Mountains through the Hoango Valley, to Lan-tschow. This town is the capital of the province of Kansu, which possesses a population of 11,000,000 persons, so that the railroad will serve a very thickly populated country. After leaving Lan-tschow the railway will extend to the province of Shensi and thence through the Hankiang River valley to Hankow. The railway, if constructed on these projections, will prove of immense service to Russia, since it will enable the products of Russian Central Asia to be carried and marketed at the great center of Chinese trade. Then again Hankow is in steamer connection with the rich province of Szchuan, which boasts a population of 46,000,000.

THE American Bridge Company has secured a contract from the North German Lloyd Steamship Company for the erection of a foundry building and a blacksmith shop at Bremen. The contract calls for 800 tons of structural steel and was secured in competition with German concerns.

ELECTRIC MINING LOCOMOTIVES.

BY FRANK C. PERKINS.

There are many features of the electric mining locomotive that render it peculiarly adapted to the transportation requirements of mining. In the first place, it lends itself readily to the restrictions as to size which are imposed by the limited width and height of the various tunnels and workings; for as compared with other forms of motors, bulk for bulk, the electric locomotive is the smallest in proportion to its tractive power. Furthermore, the transmission of the power involves nothing further than the stringing of the wires, which, as shown in our illustration, Fig. 3, may be carried in one of the upper corners of the tunnel, where they are entirely out of the way of passing traffic. Electric haulage, indeed, forms by no means the least valuable part of an important revolution which is being effected by the introduction of electrical power into mining practice.

There are three or four general types of electric mining locomotives as manufactured by the leading builders. The first class are centrally controlled, as illustrated in Figs. 1 and 3. These locomotives are built with the wheels inside the frame; though also frequently made with the wheels outside where the gage of the track permits of a choice. The second class of mining locomotives are controlled from one end only, as shown in Fig. 2.

The centrally controlled electric mining locomotives of the heavier type, weighing in the neighborhood of 15 tons, shown in Fig. 3, are frequently equipped with three sets of wheels and axles, and a motor located on each axle. One of this type is shown just coming out of a mine entrance in Ohio and is operating on a two per cent grade. The draw-bar pull is 5,500 pounds and the terms of weight on driving wheels, which is the factor determining their tractive power, and not in terms of horse power, which varies with speed.

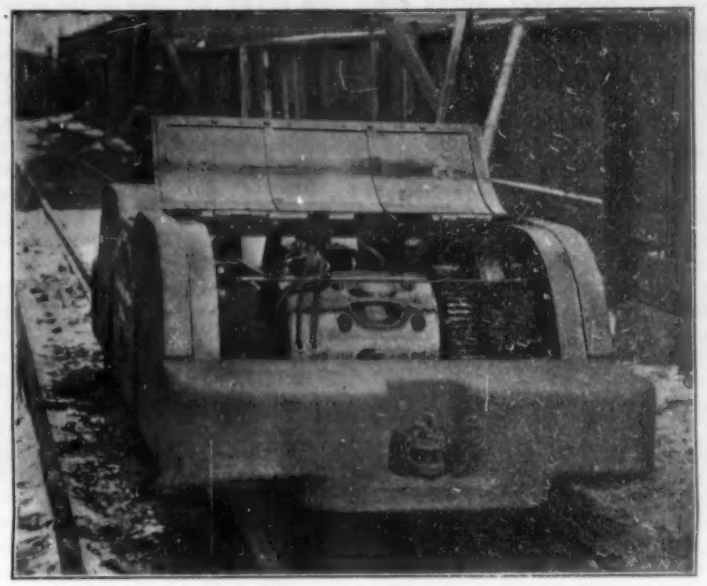


Fig. 1.—CENTRALLY CONTROLLED MINING LOCOMOTIVE.

Cover lifted, showing arrangement of motors, gearing, etc.

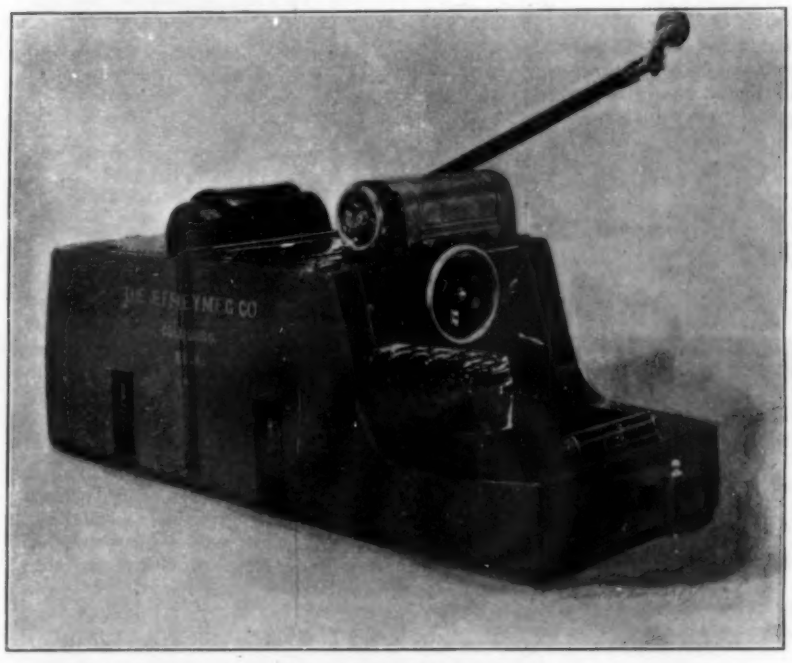


Fig. 2.—SINGLE-END, GONDOLA STYLE, ELECTRIC MINING LOCOMOTIVE.

Now in use at Paris Exposition. Weight, 8,000 pounds; drawbar pull, 1,000 pounds.

capacity of each of the three motors is 35 horse power. The frame is supported, as the reader will notice, upon springs which are connected together by links, thus allowing the equalization of the weight on uneven tracks.

The Westinghouse single-end locomotive now being operated by the Shawmut Mining Company is equipped with two motors operating at 220 volts. The full-load speed of this locomotive is 8 miles per hour, and its total weight is 16,000 pounds. The draw-bar pull in starting is 3,500 pounds, and while running is 2,100 pounds. The drivers are 30 inches in diameter, and the wheel base 44 inches.

At the Paris International Exposition the electric mining locomotive shown in Fig. 2 is being used about the grounds. It is of the gondola style, and was manufactured by the Jeffrey Manufacturing Company for the Paris Exposition Company. Its total weight is 8,000 pounds, and it has a draw-bar pull of 1,000 pounds.

Two 20 horse power motors are used on the Paris Exposition locomotive and they are capable of operating at from 6 to 10 miles an hour.

The number of tons weight of train which an electric mining locomotive will haul, at standard speed, on straight track may be accurately estimated when the grade and frictional resistance of the cars are known. The frictional resistance varies greatly with the kind of cars, the condition of the journals and the conditions of the track.

The amount of friction varies from 20 pounds to 70 pounds per net ton for ordinary coal mine wagons; and if the track is out of surface or gage and the cars are overloaded, an indefinite amount of train resistance is added.

Electric mining locomotives are usually rated in

Dragon-Fly Nymphs.

In an instructive article by the Rev. Arthur East in Knowledge, some theories of the method of respiration of dragon-flies are brought forward. The writer says: "Of more than two hundred individual nymphs of Æschna cyanea observed, every one spent about the last two weeks of its aquatic life (minus the final two or three days) with the tip of the abdomen clear of the water, and the anal passage open to the air; when disturbed, the nymphs would descend a short distance down the stick they rested on into the water, and return very shortly to their former position. During the two or three days immediately preceding emergence the position was reversed, and the head and thorax were protruded into the air as far as two large breathing apertures on the fore part of the body, called the thoracic spiracles. These spiracles under a lens could be seen to be open, and they are connected with well-developed tracheæ. This habit suggests very strongly that during the last fortnight of its aquatic life the nymph breathes the outer air direct into the tracheal system. Being anxious to know whether this faculty is confined to the later nymph stages alone, the writer lately procured some nymyhs of Æschna cyanea, about 1¼ inches long, and kept them out of water in damp weed, and the result is not a little surprising.

"Two nymphs have been living out of water for more than two months, with only 'short intervals for refreshment,' and are as well and vigorous when put back into water as when first removed from it, and take their food with the wonted appetite of their kind; the intervals between visits to the water have varied from two days to twenty-eight days, and the times in the water have varied from two minutes to twenty hours; during its aerial periods the nymph is perfectly quiescent on the weed, and resumes its aquatic life exactly where it left off. Nor does this extraordinary faculty of living in both elements alternately seem confined to nymphs of which Æschna cyanea is an example."

The Perishability of Paper.

The perishable character of modern paper is due primarily to the use of wood pulp which is not thoroughly made, and the introduction of loading materials. The Prussian government took the matter up and passed very stringent laws upon the subject. Standards of quality were set up, and all papers for documents must be submitted to official tests.

Atomic Weight of Radium.

In a communication recently made to the Académie des Sciences, M. Curie states that he has succeeded in making an approximation toward the atomic weight of the new element radium. Since the commencement of his researches for isolating the new element, the progress of its concentration in the chloride of barium has been constantly observed by the study of the spectrum and determinations of atomic weight. Each time that the treatment of the mineral gave a new quantity of the chloride, this was submitted to a systematic series of crystallizations in order to give a small quantity of a product as concentrated in radium as possible. A part of this was treated with hydrochloric acid to give a very pure product, which M. Demarçay has found by the last series of spectrum analyses to contain only traces of barium, and may be considered as an almost pure chloride of radium. The quantity of pure salt isolated in this way is insufficient, however, to obtain the atomic weight of radium, and M. Curie, in his last determinations, used the product containing a larger proportion of barium, of which he had 6 grains. A determination was made at the same time upon pure chloride of barium as a check. After indicating the process used for finding the atomic weight of each product, M. Curie states that the weight found for barium gives the number 138, and that of the product containing radium, 174·1 and 173·6 in two cases. There is no means of finding the relative amount of radium and barium in the latter product, but M. Demarçay concludes from the spectrum that there is a greater proportion of radium. It is, therefore, certain that the atomic weight of radium is much greater than 174. The quantity of pure chloride of radium isolated is not sufficient to allow the study of the properties of this element in a pure state, but its existence is no longer a matter of doubt.

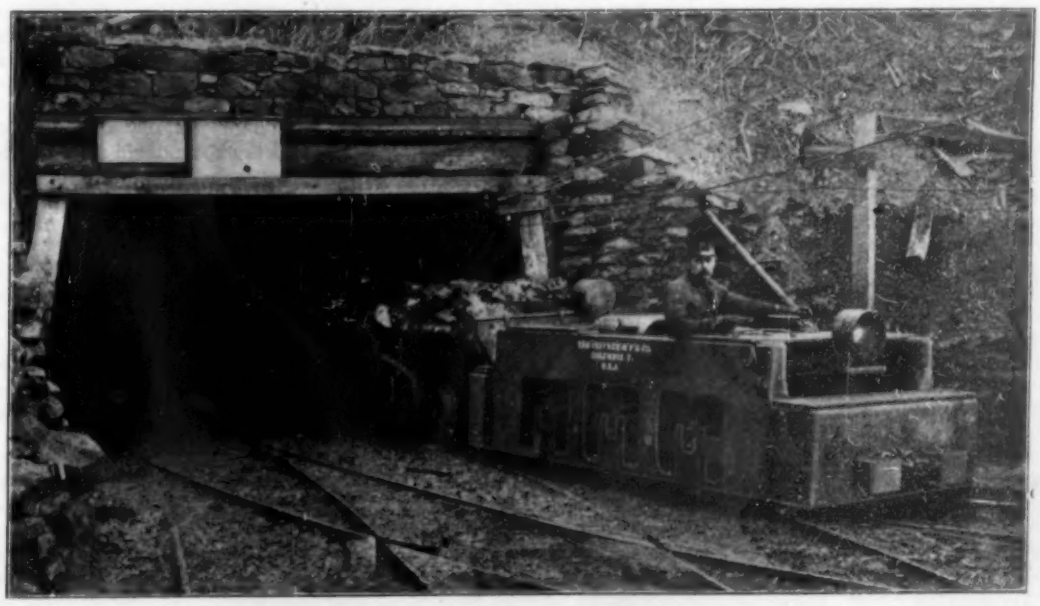


Fig. 3.—CENTRALLY CONTROLLED MINING LOCOMOTIVE.

Weight, 15 tons; drawbar pull, 5,500 pounds.

THE ST. LAWRENCE POWER COMPANY'S PLANT AT MASSENA, N. Y.

There is nearing completion at the little town of Massena, N. Y., near the St. Lawrence River, one of the latest and largest of the hydraulic electric power plants, the development of which is one of the most significant features in the world of engineering at the close of the nineteenth century. The earliest of these was the installation of the Niagara Falls Power Company, at Niagara, of which we have at various times given very complete illustrations. This plant has a capacity at present of 50,000 horse power, and a second wheel-pit is now being excavated which will exactly double the capacity. Another extensive plant for the utilization of the waters of the Great Lakes is that which is being constructed at the Sault Ste. Marie rapids, where works are in progress for the development of 60,000 horse power.

The ambitious undertaking which forms the subject of our front page engraving contemplates the development ultimately of 150,000 horse power, although the works at present in progress are designed for an output of 75,000 horse power, this being the capacity of the present canal. By a study of the accompanying plan of Massena and its surroundings, it will be seen that the natural conditions are remarkably favorable to the development of a scheme like the present one. For several miles in the vicinity of the Long Sault Rapids, in which the St. Lawrence River undergoes a fall of 50 feet, the Grasse River flows approximately parallel with the St. Lawrence at a distance of a few miles from the same, ultimately discharging into that river below the rapids. At the head of the rapids the level of the St. Lawrence is about 42 feet higher than that of the tributary stream, and advantage has been taken of this fact to cut a canal across the intervening country and utilize the head of water which is thus secured in a power plant located on the banks of the Grasse River, which is utilized as a tail-race for the discharged waters. The effective head above the Grasse River level at the power house is 35½ feet. As at present constructed, the canal has a surface width of 192 feet, and a depth of 18 feet. The present capacity of the whole scheme is limited by the capacity of Grasse River, which has sufficient sectional area to carry away the tail-race waters for a development of 75,000 horse power When this point has been passed in the development of the scheme, dredging operations will be necessary in the Grasse River; but it will be possible by dredging out the same and making full use of the capabilities of the canal, as ultimately enlarged, to produce a maximum of 150,000 horse power. The hydraulic-electric plant which is now being erected at the power house will have a capacity of 37,500 horse power; and the extension which is immediately to be made will bring up the equipment to a total horse power of 75,000.

By the courtesy of the St. Lawrence Power Company, a party made up of the representatives of technical journals of New York was recently taken down to Massena as guests of the Power Company, and driven over the work, every facility being extended by Mr. William F. Zimmermann, the general manager, and Mr. T. A. Gillespie, the contrator, of the St. Lawrence Power Company, for a thorough examination of the same. As a result of the very quiet manner in which this company has executed a work of this magnitude, surprise was expressed at the advanced stage to which it had been pushed. Of a total estimated excavation of 5,922,000 yards, 4,500,000 yards had been removed. The canal, which is about three miles in length, has been so far advanced indeed that it is likely it will be ready for use during the spring of next year. The concrete work of the power house is completed and roofed in, and the work of installing the turbines and generators is being actively prosecuted.

The power house, which is being built upon the bed rock of the Grasse River, will ultimately be nearly seven hundred feet long, with a width of about 150 feet. The fifteen 6,000 horse power turbines, or rather sets of turbines (each set consisting of six wheels), which will be here installed, are of the well known Victor type. These turbines will be placed upon horizontal shafts in three sets of two wheels each. This is in marked contrast to the turbines at Niagara, which, with their corresponding generators, are mounted upon vertical shafts. The Niagara shafts are 150 feet in length, while the horizontal shafts at Massena are but 80 feet long. The six turbines of each set will develop power sufficient to operate one 5,000-horse power generator. Such structural differences as there are between the two outfits are due to the difference in the character of the two water-ways, the fall at Massena being less, and the volume of water greater than at Niagara.

The power house will have a height of about 60 feet, giving ample head room for an 85-ton overhead electric traveling crane, which will run throughout the entire length of the power house. In addition to the fifteen sets of turbines for driving the large generators, there will here be installed three smaller turbines, operating three direct-current generators, to be used as exciters for the main machines. Direct current is required for exciting alternating current machines, and this may be furnished by a small direct-current machine rotating on the same shaft with the large machine, or else separately driven. For the plant of the Power Company, as in practically all other large supply systems, separate exciters are provided, and in this case, as stated, they are operated on separate shafts, and by separate turbines.

Each of the enormous main generators, giving an output of 5,000 horse power, will weigh 175 tons. The generators will stand about 22 feet above the tops of the foundations, and each machine will measure on the ground 22 feet by 18. The generator shaft is a continuation of the shaft upon which one set of the turbines is mounted. This shaft carries the revolving field, which is in effect a huge steel wheel, 15 feet in diameter and 3 feet wide, cast with ten massive spokes. This field magnet is designed to rotate at a speed of 150 revolutions per minute, which gives a speed at the circumference of about one and three-quarter miles per minute. The wheel carries twenty externally projecting pole pieces, and rotates within a large stationary ring built up of thin soft steel disks held by a massive outside cast iron yoke. These thin steel disks constitute the stationary element of the magnetic circuit of the generator. Along the inner face of the ring which is thus built up are provided slots in which are laid the copper conductors of the armature. These copper bars are mica-insulated. The rotating wheel (which, with its projecting pole pieces and copper windings supplied with current from the separate exciting machines, forms the field magnet of the generator) induces an alternating current in the copper windings of the stationary outer ring or armature. It is this current which, at a pressure of 2,200 volts, will give an electrical output of 5,000 horse power. This current is carried to a main switchboard, the various machines being connected therewith by means of a set of massive copper bus-bars.

The method by which the output of 75,000 horse power will be controlled possesses unusual interest, on account of its simplicity. One man, by manipulating a series of electric buttons, arranged on a small stand, will be able to control instantaneously the whole out-

PLAN SHOWING LOCATION OF THE MASSENA POWER CANAL.

put of 75,000 horse power. Running the length of the power house will be a raised platform, in the middle of which will be built a central controlling stand, made desk-fashion and semi-circular in shape, so that an engineer stationed at its center will have within reach the controlling apparatus of the entire station. This controlling stand will carry a number of marble slabs or tablets (one for each generator), upon which will be mounted small controlling keys. These keys are arranged on the interlocking system, and they will operate, by means of local battery circuits, a series of compressed air valves and pistons. The latter will, in turn, control a series of fifteen switching stands, one for each generator, equipped with the necessary cut-outs and switches. The stand will be located under the raised platform and approximately opposite its corresponding generator. Each stand will carry three-pole carbon shunt circuit-breakers, in series with which will be three-pole double-throw switches. The circuit-breakers and switches are controlled by means of compressed air, as previously stated, from the central controlling stand operated by the engineer. Stands similar to the switching stands are provided for the different outgoing circuits. The operator thus has under his eye at every moment the huge generators themselves, their corresponding switches and indicating instruments, and in reach of his fingers are the electric buttons, by means of which the entire plant is regulated and controlled.

The current thus generated will be used for a variety of purposes. It is adapted for use in operating induction motors, which, because of their ideal simplicity of construction and operation, are coming widely into use in place of the more delicate and complicated direct current motor for general power service. It can be used for lighting and heating, and for electrolytic work, as well as in a great variety of electro-chemical processes, such as the manufacture of aluminium, calcium carbide and other products which have been made commercially available only through the application of electric power at extremely low cost, as furnished by such means as the Niagara and the St. Lawrence plants. For some of these purposes the high tension alternating current has to be transformed into low pressure direct current, and this is readily done with very small loss, by means of the modern rotary converter.

Massena is an unusually good center for such a purpose, as its facilities for transportation are excellent. The New York Central and Grand Trunk lines intersect here, and the Vermont Central Railroad and the New York and Ottawa Railroad come within a short distance of the town. Large lake vessels may be admitted to the power company's canal, thus affording direct communication by water with the lake system. If necessary, in the future, a lock may be constructed which will pass vessels from the canal into the Grass River, and thence back into the St. Lawrence River. Such a plant as this affords ideal facilities for the transmission of the electric current over great distances, as is done from the central power plant at Niagara, but it is not the intention of the St. Lawrence Company to so transmit it; but rather to furnish the power at such low rates that manufacturing establishments will find a strong incentive to locate in the vicinity.

Automobile News.

One thousand five hundred motor car licenses have been taken out in Belgium from January 1 to August 30.

The 50-mile championship cup offered by The Chicago Inter-Ocean has been awarded to Mr. Alexander Winton.

Self-propelled lunch wagons are to be built at Worcester, Mass., where is the headquarters of this distinctively American institution.

Fairmount Park has now been opened to automobiles, and the restrictions which were formerly imposed upon them have been removed.

An automobile freight line will shortly be established between Los Angeles, Pomona, Ontario, and Chino, Cal. A 40 horse power automobile truck capable of hauling eight or ten tons of freight at slow speed will be used.

The Transportation building at the Paris Exposition has a series of decorative symbolical figures. It would seem as though the bicycle and automobile would hardly adapt themselves to artistic treatment, but the result is fairly successful.

The Boston Park Board has extended the time within which horseless carriages can be driven in the park system. Automobiles can now be run from 8:30 until 11:30 in the evening. The vehicles must not travel at a higher speed than 10 miles an hour in the park.

King Leopold, of Belgium, has given an order for a 20 horse power carriage and an electric brougham, both of the Panhard-Levassor make. The king has also asked for plans of a van for servants' baggage and for an omnibus to run between the royal palace and the railway station.

A large iron works at Pueblo, Col., contemplate ordering a large motor vehicle for the purpose of conveying workmen to and from the plant. The proposal provides for a 25-seated car, which will start at six in the morning and following a certain route to the works pick up the men en route.

The Park Commissioners of San Francisco have at last decided to admit automobiles in Golden Gate Park after the drivers have obtained permits. They must appear before the Commissioners, and if they are considered competent, a permit will be given to them irrespective of the motive power of the machine.

Preparations are going forward in Washington, D. C., for an automobile show, which will be held during the week the National Capital centennial is celebrated—December 10. The purpose of the exhibition is to bring together in Washington representative exhibits of automobiles of every type and description, and to illustrate in this way the development and possibilities of this important branch of industry. No city in the country is better adapted to the use of automobiles than is Washington, and it is expected that the forthcoming show will exert an important influence in the development of the industry in that city.

Private automobiles will pay taxes in cities in Spain of $11.58 for each vehicle, and for each seat including driver, $1.36. In smaller cities the tax is decreased, and in places of less than 20,000 inhabitants the tax is further lessened to $2.89 for each vehicle and 34 cents for each seat. Horseless vehicles for traveling along the public roads will pay for each 0·6 of a mile 58 cents, and for each seat for 0·6 of a mile 3·5 cents. It would seem that these excessive taxes would eventually prevent the use of any automobiles, specially those for traveling along the public roads. This is very short-sighted policy on the part of the authorities, because the automobile could easily work a revolution in transportation in Spain, where it is specially needed.

Correspondence.

"Distant Water Powers."

To the Editor of the SCIENTIFIC AMERICAN:

An article appeared in your journal of September 22 last under the heading of "Distant Water Powers," which, knowing your usual care in admitting figures to your columns, appears to throw doubt on the value of water powers. Coming from your authority, it has been copied elsewhere. It is, perhaps, not intended to apply to power companies, and the power which they retail at so much per horse power, but to those who, being large users of power, have to consider the relative advantages of a steam plant or of a distant water power and an electric plant and transmission line. No such distinction, however, is being made here, and the article is looked upon as depreciating the importance of water powers, and this is a country where water power is abundant, and is now being largely taken advantage of. We are fast acquiring experience here, and that experience has not been without its difficulties, which have shown that not every water power is valuable for electrical transmission.

I, however, do not wish to go into details, but merely to point out, from United States sources, one or two facts which cast doubt upon your figures and suggest at any rate a revision of your conclusions. A well-known Pittsburg electric company gives the efficiency of the generators as 94 instead of 96; of the transformers as 97½ and 97 respectively, instead of 95 each; and the line efficiency as 89 with the requisite copper, instead of 85. Further, if $86.15 per horse power, delivery capacity, is the cost of electrical transmission equipment without the transmission line, it is greatly higher than we obtain it here and much too high for the most economic work. On the other hand, in regard to steam, Power for November last gives the results of tests of 35 different steam engines for coal consumption, and shows that the best result came from the compound condensing Corliss engines, which averaged 2·36 pounds per horse power per hour with good coal. This for a 12-hour day would be, as the writer points out, 5·17 tons per horse power per annum, which at $3 per ton equals $15.51 per horse power annually, instead of $11.25 which you give. It is not always that we find the best Corliss engines in our factories and not always is the best coal used, and thus the coal cost runs up all the way to $30 per horse power per annum for the 12 hours daily and with coal at $3.

It will interest you further to know that one of our power companies (Chambly) has just sold to the Montreal Street Railway 5,000 horse power at $25 per horse power per annum, and the balance of its power up to 15,600 horse power at, it is said, $15, and all after that at $10, to the Royal Electric Company, which will retail it in Montreal. Again, the town of Orillia, Ontario, offers to manufacturers its own transmitted power, brought from the Severn River, 12 miles off, at $15, but the power being limited in amount, we think this figure too low, although, no doubt, the town expects its return in increased population and increased taxes. At the Shawinigan Falls, Three Rivers, there are preparations going on to deliver power in Montreal, 80 or more miles away, and compete with the Lachine and Chambly companies, which have only 4 and 20 miles respectively across which to transmit their power from the Lachine Rapids on the St. Lawrence River and Chambly on the Richelieu River.

Kingston, Canada, October 27, 1900.

ANDREW T. DRUMMOND.

REPLY TO MR. DRUMMOND.

To the Editor of the SCIENTIFIC AMERICAN:

Your favor of Oct. 30 with that of Mr. Drummond in hand. The article in your issue of Sept. 22 did not attempt to show that water powers are not desirable sources of energy, but simply that it does not pay to transmit their energy to great distances where coal can be had at ordinary prices. The efficiencies named in the article are fully as high as can be expected for good electrical equipment under average conditions of load. The figures of 97½ and 94 per cent, named by Mr. Drummond, cannot be maintained under conditions of practical work. My figures for the cost of electrical equipment per delivered horse power capacity, that is $86.15, are based on $25 per horse power capacity for dynamos and motors, and $10 for transformers. If it can be shown that these prices are too high, I shall be glad to know of it.

The figure of $11.25 for coal at $3 per ton, per working year of 3,000 horse power hours, is based on 2·5 pounds of coal per horse power hour, a result that has been frequently and is regularly surpassed in many large plants.

I am aware that electrical energy from distant water powers is offered at very low figures, in some cases, by those who have stock to sell or other interests to promote. I am not able to learn, however, that corporations transmitting electrical energy from water powers to great distances, and selling it in competition with steam power at large plants, are usually able to pay dividends. Good water powers may be of much advantage to industry, but this advantage can only be secured, in a country where coal is cheap, by the location of factories within a few miles of the source of energy, as is the practice about Niagara Falls. For distances of 5 or 10 miles, the cost of the necessary electrical equipment is less per unit of delivery capacity than for distant transmissions. ALTON D. ADAMS.

The Remarkable Trial Trip of the "Variag."

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of August 11 last, you printed a paper on high speed in war vessels, involving comparison of the "Variag" and the "Viper."

At the time this appeared I was at Bar Harbor, and intended to acknowledge it as soon as I returned home, but overlooked it.

I now see that the paper has been reproduced in the Proceedings of the United States Naval Institute, which recalls my attention to it.

Permit me to both thank you for your kind expressions and compliment you on the ability displayed in the paper itself.

Your remark that "on a preliminary trial she is said to have logged for a time the remarkable speed of 24·6 knots an hour," etc., is not as clear as it should be. The word "logged" should not have been used, because the speed referred to was not determined by that method; it was the actual speed between fixed points.

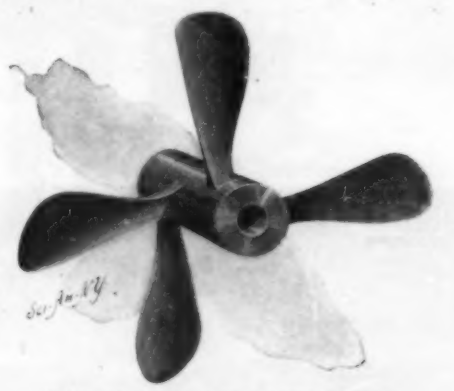
I might also observe that the most important fact connected with the trial of the "Variag" has apparently been overlooked, that is to say, the fact that her performance was effected under natural draft. It is only by keeping this element of the performance in view that its real magnitude can be fully appreciated.

CHARLES H. CRAMP, President.

The William Cramp and Sons Ship and Engine Building Company,
Philadelphia, Pa., November 3, 1900.

A SCREW-PROPELLER OF NOVEL FORM.

Our illustration represents a peculiar form of screw-propeller, for which its inventor, Mr. Carl Rondell, of



THE RONDELL SCREW-PROPELLER.

Stillwater, Minn., claims an efficiency greater than that of the screws commonly employed. Mr. Rondell states that with the ordinary propeller, with its blades arranged to travel one within the path of the other, an air-space is produced by reason of the displacement of the water by any particular blade. As the speed increases, the displacement is more marked and the loss of efficiency, it is said, more pronounced. The salient feature of the present invention is to be found in the arrangement of the propeller-blades, one in advance of the other, or in offset planes, so that the different propeller blades are caused to rotate in different planes, one in advance of the other. By this simple arrangement each blade, it is claimed, will always work in the body of water which has been passed through by the advance propeller-blade, and each blade finds its maximum base of resistance in the water. A maximum of efficiency at very high speeds is therefore obtained.

United States Rolling Stock in New Zealand.

New Zealand has recently placed with one of our well-known firms an order for sixty-odd passenger coaches at a cost of about $500,000, to be built under the supervision of a railway official who is now en route to the United States. The placing of this order has caused much adverse criticism among the labor parties, but the government does not appear to be greatly perturbed. The order calls for specially designed and constructed coaches to suit the narrow-gage railways throughout the colony, and they will be of the latest and most modern pattern, including every up-to-date improvement known to American car builders. It is expected that these coaches will be shipped from New York city in March, 1901.

Mr. Ward, the minister for railways, while in the United States last year, thoroughly studied our railways, coaches, locomotives, and general management, and has, in consequence thereof, inaugurated many reforms in his department.

Engineering Notes.

The Dutch government has ordered 12,000 tons of American steel rails for use in the Dutch colonies of India and Java.

The Bavarian government is having a car built in Nuremberg on the American plan, the woodwork and metal fixtures being sent by the Pullman Company, which also furnished one of its constructors to superintend the building of the car.

In a recent issue of our SUPPLEMENT we mentioned the products of the Elmore Company, in which it was stated that copper tubes 12 inches in diameter, 20 feet long, have been produced by the Elmore process. We are informed that this company has been able to produce tubes 8 feet in diameter and 18 feet long, the tubes being, of course, undrawn. The company produces drawn tubes 12 inches in diameter and 35 feet long.

An explosion of acetylene gas took place at Austin, Ill. A stereopticon entertainment was being given in the First Presbyterian Church, and the operator, who had recently returned from missionary work in India, lost his right hand and sustained other injuries. The gas was in cylinders, and one of them sprung a-leak, and the light that was in the lantern ignited it, causing the explosion. The middle tier of seats, where the tanks had been placed, was wrecked, and the large windows were blown out. The fire was extinguished.

The responsibility for the Boston gas explosion of March 4, 1897, has been placed on the Boston Gas Company. We illustrated the accident in the SCIENTIFIC AMERICAN for March 20, 1897. It will be remembered that twelve persons died of their injuries, and many more were seriously hurt. It is supposed that a spark from a trolley car fired the gas which accumulated in the excavation. The accident naturally entailed a vast amount of litigation, and finally the matter was taken to the State Supreme Court, which has awarded $3,000 for personal injuries to a bootblack, thus affirming the judgment of the inferior court.

The penetration in the Simplon tunnel at the end of June had reached 18,456 feet, and the entirely completed portion was 10,500 feet long. The temperature of the rock at a distance of 7194 feet from the southern end was 92° F., while 10,464 feet from the northern end it was 80°. It is calculated that at the center of the tunnel the heat due to the thickness of the superincumbent rock will be 109°, which would be insufferable to the workmen but for abundant ventilation with cooler air. At the end of August the aggregate penetration was 20,231 feet. The number of workmen employed is 3,000 on the Swiss side and 2,500 on the Italian side.

Coal consumption in blast furances varies with the amount of moisture in the air. In a discussion before the Pittsburg Foundrymen's Association it was stated that under normal conditions with the temperature at 70° Fah., 1,000 cubic feet of air equal to 75 pounds contains 1 pound of moisture, and that each pound of moisture requires one additional pound of coke. Tests have proved that when the air is charged with moisture, from 200 pounds to 300 pounds more coke are required for producing at ton of iron than when the air is dry and comparatively little moisture is blown into the furnace. Heating the air does not eliminate the moisture.

Tests of the corrosion of pipe by the earth along the route of the Coolgardie pipe line have recently been made, says The Engineer. Specimens of pipe, both coated and uncoated, were buried at several different points in November, 1898 and these were dug up and examined on April 24, 1900. In all cases the pipe coating was found to be dry and friable, with a thin film of rust in places on the metal under the coating. There was no pitting of the metal, however. The pieces of uncoated pipe buried in sand or clay were very slightly pitted. A piece of uncoated pipe buried in the "salt lake pan," however, was very materially affected, being covered with pits about $\frac{1}{10}$ inch deep over its whole surface.

A new rail rolling process is in use at the Edgar Thomson Steel Works, at Braddock, Pa. The rails are rolled at a lower temperature than has usually been employed. Formerly the blooms were sent to the rail mill and rolled at a white heat. Almost as soon as they were placed on the hot beds they were sent to the presses, and straightened while at a high temperature. As they were rolled and straightened while very hot, the rails expanded again before cooling off, and much of the toughness of the fiber, which they should have possessed, was lost. It is found that with the new process the tensile strength of each piece was much greater than under the old system. The new process is very simple and consists in "breaking down" blooms while at a cherry red heat, and then sending them into the rail mill and the press. The rails for the Pennsylvania Railroad Company are to be made by the improved process, and as the steel is, of course, much harder to work than when at a higher heat, the engines must be more powerful to roll them.

THE NEW BATTLESHIPS.

The SCIENTIFIC AMERICAN published, in its issue of June 9 last, an illustration and description of the three battleships then designated "Georgia," "Pennsylvania," and "New Jersey." Some time later, after the report of a special board, the Navy Department assigned those names to the three ships that are to carry superposed turrets, which we now show, while the two vessels appropriated for by the last session of Congress, bearing the names of "Virginia" and "Rhode Island," will be as described and pictured in our issue of last June.

Without going into the merits of the case, the majority decision of the special board in favor of arming three of the five new battleships with superposed turrets followed directly upon the final acceptance trials of the "Kearsarge." The object of the board's being was the determining of the better type of ship, all five, of course, to be alike, and the decision or recommendation showed the board to be hesitating in judgment. The result is to miss the prime opportunity of fashioning five ships of absolute similarity, a feature of fighting efficiency in combined operations hardly to be overvalued.

In general dimensions, these ships will be like those described previously. They will have a load-water-line length of 435 feet; an extreme beam of 76 feet 10 inches; a trial displacement of 15,000 tons; a mean draught at trial displacement of 24 feet; a greatest draught, full load, of 26 feet; a total coal bunker capacity of 1,900 tons; and a trial speed of 19 knots.

The most important difference in hull between these ships and the two of later appropriation is in the wood-sheathing and coppering which these ships will receive. Throughout the bottom and bilges and up to a height of three or four feet above the waterline there will be a thick covering of fine pine carefully tapped to the underlying metallic skin and rendered water-tight and non-galvanic. Over this will be laid the copper. The advantages of this system are too well known to need explanation here; and, in consequence, the ships will prove far more economical in their consumption of coal, readier at all times for high power service, and able to maintain their speed even after months in the fouling waters of the tropics. Such of our sheathed and coppered craft as have done service in the Far East have proved valuable practical examples of the advantages of this system of bottom protection.

In hull form there will be a novelty, common to all five of the new battleships, in the way the uniform freeboard of 20 feet is maintained from bow to stern. Apart from the military advantage gained in the added height of the guns of the main battery aft, there will be a net gain in accommodations of infinite comfort and healthfulness to both officers and crew. None of them will be shut up behind the blank walls of heavy armor, as heretofore, lighted only by artificial means, but the living spaces will all have air ports and direct access to sunlight. This added freeboard aft, too, will make the ships more weatherly in a following sea.

The armor protection to the hull will consist primarily of an 8-foot water-line belt, 5 feet of which will be below water at load draught. The maximum thickness of this belt is maintained amidships for a distance of 192 feet abreast the engines and boilers. From the top downward 5 feet, this armor will be 11 inches through, and thence to the armor shelf it will taper to 8 inches. The belt is continuous from bow to stern in varying thicknesses. For a distance of 60 feet forward and 32 feet abaft the central portion, the plates are to have a maximum thickness of 9 inches and a minimum of 6, the maximum 9 inches ranging downward 5 feet. For a distance of 16½ feet forward and aft, the next course of armor will have a greatest thickness of 6 inches and a least thickness of 4½, the limits of dimensions, as in all following cases, being similar to those in the portions already described. Seventeen feet forward and aft, next, the armor will have a maximum thickness of 5 inches and a minimum of 4, while the remaining armor, running forward to the bow and aft to the stern, will have a uniform thickness of 4 inches. This armor will be treated by the Krupp process.

Above the main belt, for a distance of 245 feet amidships, i. e., throughout the position of the main broadside rapid-fire battery of 6-inch guns, the sides will be reinforced by armor of a uniform thickness of 6 inches. This armor will reach all the way up to the main deck, and it will be joined to the barbettes of the 12-inch turrets by athwartship armor of 6 inches in thickness aft, and by inclined armor of like thickness forward, yielding, in this latter case, the added protection of glacis against the head-on raking fire of an enemy. The after athwartship armor is vertical.

There will be a curved protective deck, reaching from bow to stern, being 1½ inches thick on the flat and 3 inches thick on the slopes. A cellulose belt 3 feet in thickness will be worked continuously from bow to stern along the sides above the protective deck. The obturating material will be the well-known corn-pith cellulose.

Wood will be used very sparingly, and, where indispensable and not exposed either to the weather or under water, will be fire-proofed. Light metal bulkheads will supplant the usual wooden partitions in the living spaces, some of the furniture will be of pressed metal, the chart-house will be of bronze, and all of the decks under cover will be laid with linoleum. To guard against the overheating of the magazines, there will be a 4-inch air space around them in addition to a coating of some non-conducting material, while certain of the magazines are to be arranged so that they may be chilled by compressed air from the refrigerating plant.

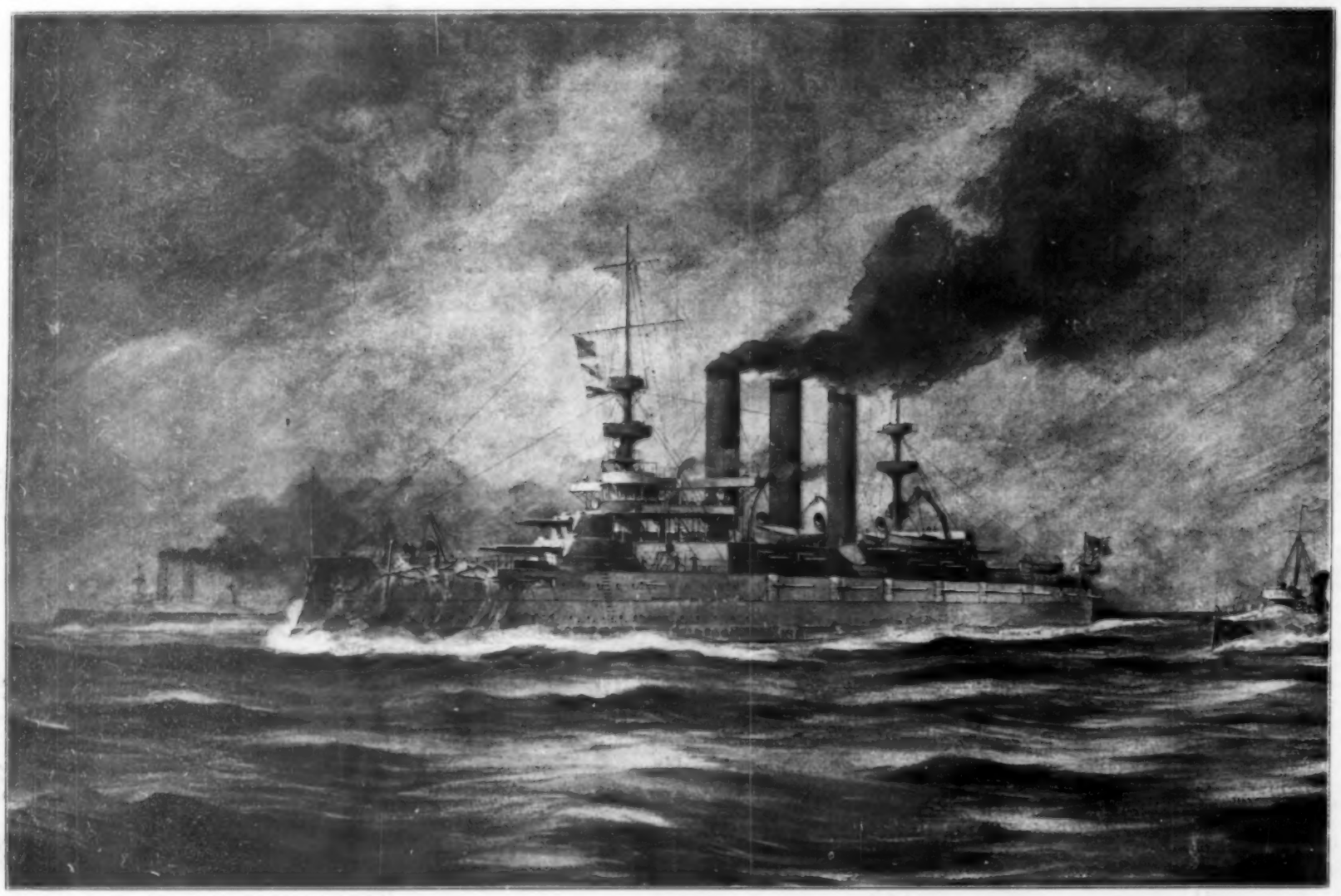
Each ship will be fitted as a flag-ship, and accommodations will be provided for 1 flag officer, 1 commanding officer, 1 chief of staff, 20 ward-room officers, 12 junior officers, 10 warrant officers, and 658 seamen and marines; a total complement of 703 persons.

The refrigerating plant on each ship will have a cooling equivalent of two tons of ice daily; and a steam laundry capable of handling the clothes of seventy-five persons per diem will do most of the washing and ironing for officers and enlisted men.

The fighting powers of the vessels will be centered in the main battery of four 12-inch and eight 8-inch breech-loading rifles, the main rapid-fire battery of twelve 6 inch breech-loading rifles, the secondary rapid-fire battery of twelve 14-pounders and a dozen 3-pounders, and the auxiliary battery of eight 1-pounders, two field pieces, two machine guns, and a half dozen 0·3 automatic guns.

The four 12-inch rifles will be mounted in two elliptical, balanced turrets 10 inches thick except for the slanting port plates an inch heavier. These guns will fire through arcs of 270 degrees. Four of the 8-inch guns will be superposed upon these turrets, fixed to move in unison, and they will be sheltered by walls of 6-inch armor increased half an inch on the slanting face plates. The four remaining 8 inch guns will be mounted amidships, two on each side, on the main deck, and will be housed in independent turrets similar to those placed above the 12-inch guns. These 8-inch rifles will have arcs of fire of 180 degrees, ranging from dead ahead to dead astern. This arrangement of the 12 and 8-inch guns gives a bow and a stern fire of six 8's and two 12's, and a broadside of six 8's and four 12's.

The 6-inch guns are arranged in broadside similarly to the ships previously shown last June. Each 6-inch gun, of which there are six on each broadside, has an arc of fire of 110 degrees, and the ports are so arranged that the guns can be turned inboard within the side



THE NEW BATTLESHIP "GEORGIA"—ALSO "PENNSYLVANIA" AND "NEW JERSEY."

Dimensions: Length, 435 feet; beam, 76 feet 10 inches; mean draught, 24 feet. **Displacement,** 15,000 tons. **Speed,** 19 knots. **Maximum Coal Supply,** 1,900 tons. **Armor:** Belt (continuous), 11 to 4 inches; gun positions, 10 to 12 inches; deck, 1½ to 3 inches. **Armament:** Four 12-inch, eight 8-inch breech-loading rifles, twelve 6-inch rapid-fire, twelve 14-pounders, eight 1-pounders, two 3-inch field guns, eight machine guns and automatics. **Torpedo Tubes,** two (submerged). **Complement,** 650.

line, the guns swinging toward one another in pairs; beginning forward, the first gun turns aft while the next one swings its muzzle forward, etc., to the after pair. This arrangement does away with the inconvenience of dismounting the guns to avoid obstructions or to guard them against the stress of heavy weather. Each of these guns is sheltered behind a heavy port shield, and there is a splinter bulkhead of 2½ inch nickel steel between each gun and its neighbor on either side. The 14 pounders, sheltered by local armor of 2-inch steel and shields, are to be mounted on the gun deck well forward and aft, and up in the superstructure on the main deck, forward and aft of the amidship 8-inch turrets. The twelve 3 pounders are to be mounted on the bridges and on the superstructure deck, while the 1-pounders, automatic and otherwise, and the Gatlings, are to be placed in the tops and in the boats.

The submerged torpedo-tubes, of which there are two, are to be placed, one on each side, well forward, and the operator is to control his tube from an armored station on the deck above, sufficiently sheltered to be proof against 6-pounder fire.

The rates of fire given previously for the two other battleships apply in the case of these vessels and will be as follows: With ammunition supplied as fast as the electrical hoists can bring it to the guns, the 12-inch guns will fire once in every 1½ minutes; the 8-inch guns once in every 50 seconds; and the 6-inch guns three times a minute.

The motive engines will be of the four-cylinder triple-expansion type, actuating twin screws, and capable of developing 19,000 indicated horse power. The steam pressure will be 250 pounds, the stroke four feet, and the cylinders will be, H. P. 35 inches, I. P. 57 inches, and two L. P. each of 66 inches. Number of revolutions a minute, 120.

There will be twenty-four boilers of the straight water-tube type, placed in six water-tight compartments. They will have quite 1,280 square feet of grate and 55,000 square feet of heating surface. The air pressure in the ash-pits will not exceed one inch of water. On trial, the ships will carry only 900 tons of coal, and a reserve of 66 tons of fresh water will be carried either in tanks or in the double bottom during that time.

An originally contemplated, one 50-foot steam-cutter or picket-boat was to have been carried by each ship, but since the report of captains of the attacking fleet during the recent maneuvers at Newport, it is highly probable that each ship will be given two for vidette service against torpedo-boats or submarine craft.

Each ship will carry quite 570 tons of offensive ammunition, not counting torpedo outfit.

Thirty-six months is the maximum time allowed for the building of each ship, and the limit of cost is $3,600,000, exclusive of armor and armament.

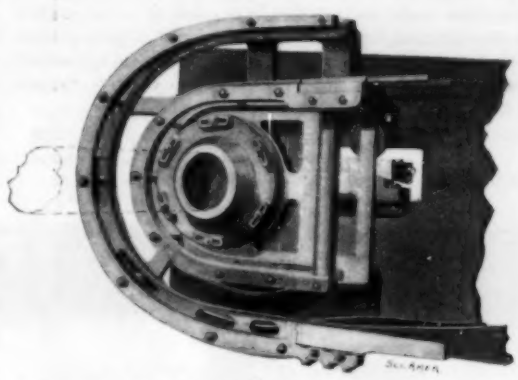
These ships were authorized by the Act of Congress approved March 3, 1899.

Long Range Firing with Heavy Guns.

Some interesting experiments at long range firing with heavy guns have been carried out by the Mediterranean squadron of the British navy. As a rule, target practice with the heavier guns never exceeds 2,000 yards, but in these experiments the range was increased to 4,000 and 7,400 yards. A target, 30 feet long by 15 feet high, covered with red canvas to make it conspicuous, was towed at a range of 5,000 yards from the battleship "Cæsar," which, at the time, was steaming at 10 knots per hour. The "Cæsar" fired in all forty rounds, sixteen of which were decided by the umpires to be excellent. On another occasion the battleship "Renown" fired at the target at a range of 7,400 yards, and scored the high total of 79 points. Only those shots were counted which would have hit a target of the same size as the first-class battleship "Cæsar." Six of the shots fired from the "Renown" would have hit the hull; one would have struck the superstructure; four would have hit the funnels and rigging; while nine overshot the target by more than 100 feet. Long range gunnery fire will in future constitute an important part of the gunnery practice of the British navy.

TRAVELING STAIRWAYS FOR THE ELEVATED RAILWAYS, NEW YORK.

The accompanying illustrations show the details of a moving stairway which is now being erected at the Twenty-third Street station of the Sixth Avenue branch of the Manhattan Elevated system. At the Fifty-ninth Street station of the Third Avenue line of the same railway company there is in operation what is known as the Reno Inclined Elevator. The latter device was the first attempt to produce an inclined moving platform for carrying passengers from one elevation to another. It consists of an endless chain of rubber-covered slats attached to a series of transverse axles, upon the ends of which are small bearing wheels which serve to engage the lateral rails upon which the belt and its load of passengers are carried. At the top and the bottom of the incline, the axles engage large sprocket wheels, the whole system returning below the sprockets and moving over them in the form of an endless chain or belt. Power to drive the device is furnished by an electric motor.

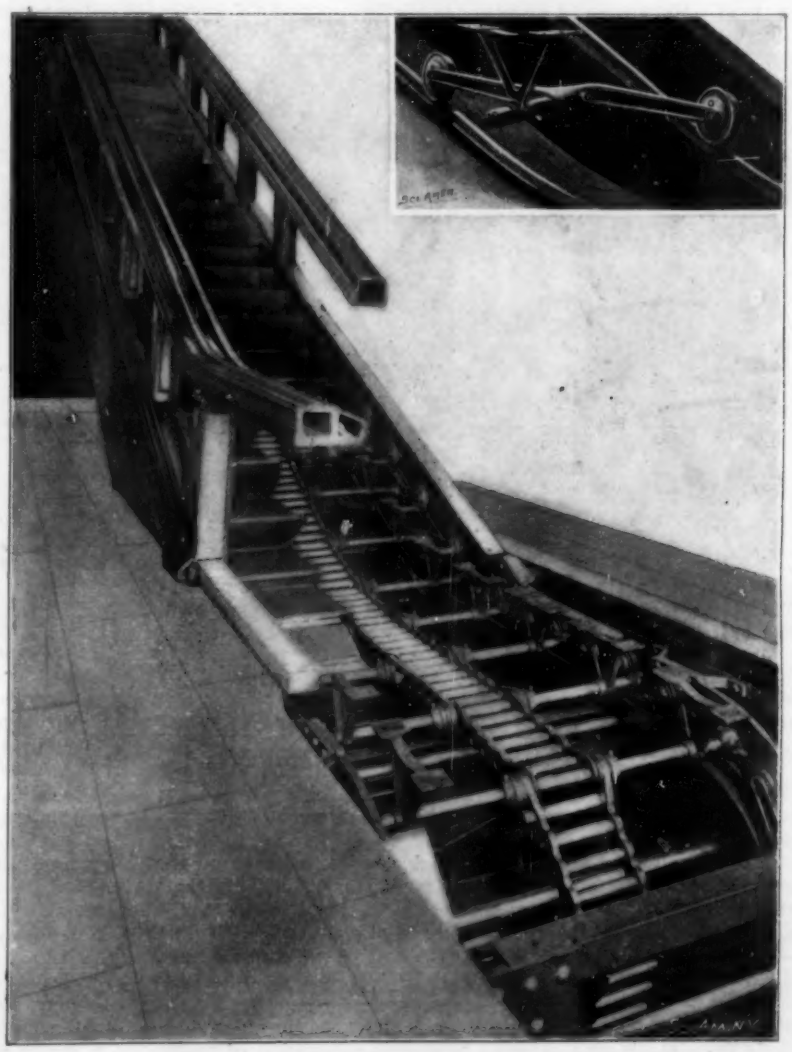


ONE SIDE OF THE DRIVING GEAR AT THE TURN.

The moving stairway at Twenty-third Street and Sixth Avenue is being built by the Otis Elevator Company and is known as the Otis Escalator. It differs from the Reno system chiefly in the fact that instead of a number of narrow transverse rubber-covered slats or bars, each element consists of the riser and tread of an ordinary stairway. As in the case of the Reno elevator, the elements are made up into an endless chain belt, which is supported during its ascent by means of small bearing wheels upon a system of side tracks, motion being imparted by means of end sprockets driven by an electric motor. Instead of a single track, however, there are two tracks on each side of the stairway, and instead of the axle of each member of the stairway having only a single carrying wheel at each end, it terminates in a Z-shaped arm, each end of the arm carrying a bearing wheel. These arms, and a pair of inverted A-brackets, which supports the steps, are rigidly attached to the axles.

As will be seen from the accompanying longitudinal section through a stairway of this kind, which is now in operation in one of the large department stores of this city, at each end of the inclined portion the stairway is carried for a considerable distance in a horizontal position. In this horizontal portion and around the end sprockets the two tracks on each side travel in the same horizontal plane, but in the inclined portion of the stairway the tracks separate and lie in different planes. The effect of this is that in the horizontal portions the treads of the steps are in the same horizontal plane, but as they strike the inclined portion of the stairway, the effect of the two tracks on each side lying in separate planes is to raise the steps, one above the other, as shown in the engraving. This ingenious arrangement throws the steps at the embarking and disembarking points into the same plane as the surrounding surface and renders it easy to enter and leave the structure. As in the Reno elevator, a hand-rail at the side travels at the same rate as the steps. To make the ascent it is merely sufficient for the passenger to stand upon any particular step and remain there, although the ascent may, of course, be made more quickly by walking from step to step as the elevator ascends. If the Twenty-third Street plant proves to be a practical success, it is likely that the new device will be substituted for the present fixed stairways at all the elevated stations. It should be mentioned that the particular moving stairway of which we present a section was shown at the Paris Exposition this year, and was awarded the Grand Prix.

LONGITUDINAL SECTION THROUGH THE STAIRWAY SHOWN AT PARIS EXPOSITION.



MOVING STAIRWAY AT THE TWENTY-THIRD STREET AND SIXTH AVENUE ELEVATED STATION, NEW YORK.

News of the Peary Expedition.

The whaling vessel "Eclipse" arrived at Dundee, Scotland, November 8, from Davis Strait, with Dr. Kann, an Austrian, Messrs. Stein and Warmbath staying behind. The explorers passed the summer at Bedford, on Pym Island, the scene of the disaster of the Greely expedition, and from this point they saw the Peary exploring expedition pass, at the beginning of August, in three divisions. The first was led by Mat Hansen and the third by Lieutenant Peary. He was badly frost-bitten, and walked with difficulty. The party had sledges and some dogs, and Lieutenant Peary was determined to make a bold dash for the Pole. Many of the 200 dogs had died, however, and he was short of provisions. It is thought that Peary will winter at Conger.

Two thousand tons of American steel rails are being sent to Italy for use on the railways.

A HOME-MADE STEAM ENGINE.

BY GEORGE M. HOPKINS.

A steam engine carefully made is a piece of mechanism to be proud of, no matter what its particular design may be. A double-acting engine of good proportions with a bored cylinder and forged crank and crank shaft, and other parts made in keeping, is, of course, the better form of steam engine to make, but, as we are presuming that not every amateur has the facilities for building such an engine, a description of a simple single-acting engine which could be made by any boy handy with tools is given. It can be made with an ordinary light foot-lathe, as no boring is required, nor is there any turning to be done that does not come within the range of such a lathe.

A view of the engine and boiler together is given, and also a sectional view showing the construction of the valve and valve-operating cam, and the steam passages in the base.

The cylinder consists of a piece, *A*, of mandrel-drawn steel tubing (which needs no boring) 2¼ inches long and ½ inch internal diameter. The thickness of the metal forming the tube is $\frac{1}{16}$ inch. This piece of tubing is fitted to a boss, *a*, about ⅛ inch high, formed on the brass block, near one end. This block is 1½ inches long and ⅝ inch thick, and is provided with lugs for receiving screws, by which it is attached to the base plate. In this block are formed the steam passages, *b c*, and valve chamber. The hole drilled from the front backward and forming the passage, *b*, receives the steam supply pipe, *B*. A hole is drilled from the rear end of the block forward to a point about opposite the center of the cylinder, forming with the hole, *d*, the steam duct, *c d*. Near the rear end of the block is drilled a $\frac{1}{16}$-inch hole, from beneath, which forms the valve seat, *e*, just beyond the passage, *b*. A $\frac{3}{16}$ inch hole is started at the valve seat, *e*, and continued to the top of the block. This smaller hole is counter-bored from the top with a $\frac{1}{4}$-inch drill, leaving the valve chamber. The counter-bored portion of this hole receives the plug, *f*, which is bored longitudinally to receive the valve stem, *g*, of the conical valve, *e'*. The valve stem is about 3¼ inches long, and is provided with the adjustable collar, *h*, between which and the plug, *f*, is placed a spiral spring which tends to keep the valve normally closed. The steam passages, *b* and *c*, are closed with screw plugs, as shown.

To the steel tube which forms the cylinder is fitted a piston of cast iron. It is about 1⅛ inches long and is packed by the steam or water contained in the grooves in the piston. The upper end of the piston is slotted to receive the lower end of the connecting rod, which is pivoted therein upon a ⅛-inch pin passing through the piston and lower end of the connecting rod, as shown in dotted lines in the sectional view.

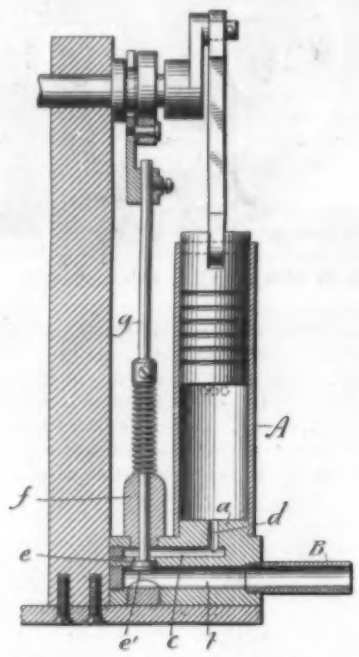
The brass block which supports the cylinder has lugs on opposite sides receiving screws which pass through them into the base plate. This plate is 4 inches wide, 5 inches long and ¼ inch thick. At the rear of the valve chamber is a post formed of a ½-inch square brass rod 4⅜ inches long, secured to the base plate by a screw passing upward through the plate into the end of the post. A similar post is placed near the rear end of the base plate. The ends of the posts are squared in the lathe. Both posts are bored transversely near the top to receive the shaft, which is ¼ inch in diameter and 5 inches long. The space between the posts is 2 inches, and the distance between the shaft and base plate is 3⅞ inches. On the shaft, between the posts, is placed the iron fly-wheel, which in the present case consists of an old valve wheel 4½ inches in diameter, bushed to fit the shaft and fastened with a set screw.

The end of the shaft which projects beyond the post over the cylinder carries a ½-inch crank on which is placed a connecting rod. This rod measures 1⅝ inches between the centers of the holes for the crank pin and the pin in the piston.

In the side of the cylinder are drilled three $\frac{1}{16}$-inch holes in a horizontal line, and close together to form the exhaust port of the engine, which is entirely uncovered by the piston when it is in the position shown in the engraving. The exhaust remains open for about a quarter of the revolution. This port is left exposed for clearness, but it may be covered by a hollow ring which encircles the cylinder and receives an exhaust pipe.

On the shaft is placed a cam, in whose boss there is a circumferential groove, and upon the upper end of the valve stem is placed a fork, the upper ends of which slide in the groove in the boss of the cam. A stud inserted in the fork has upon it a roller which rolls on the higher part of the cam and opens the valve at the proper instant. This cam opens the valve just before the piston reaches the lower limit of its stroke, and allows the valve to close just before the exhaust is opened by the piston.

The boiler of this engine consists of a copper float to be found in the market, made by an electrolytic deposit of copper. Such a float forms a seamless boiler capable of withstanding a great pressure, say 100 pounds. The boiler is mounted in a tripod made of band iron and is furnished with a safety valve ¼ inch in diameter, the lever of which is about 2 inches long, and graduated and weighted so that it will blow off at 35 pounds, thus insuring perfect safety. (The ordinary copper float is not recommended.) A brass steam pipe, ⅛ inch internal diameter, is screwed into the safety valve casing below the valve seat, and has at its end a miniature angle valve which is connected to the engine by the inclined pipe, and by elbow and nipple which extends into the base. As the angle valve is a troublesome piece of work, an ordinary stop cock is recommended in its stead. It should be placed in the inclined pipe.



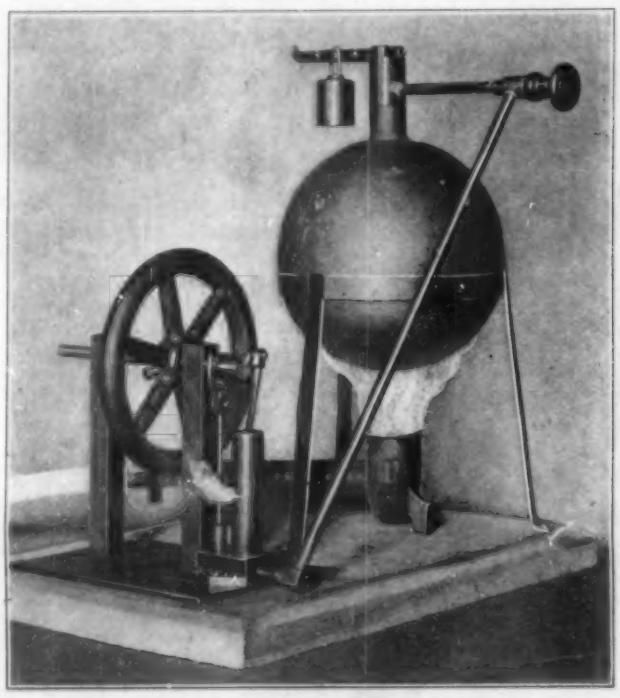
SECTIONAL VIEW OF ENGINE.

The best burner for this boiler is an Argand gas Bunsen burner like that shown. Of course an alcohol lamp will answer, but it is not as safe as the gas burner.

Both engine and boiler should be mounted on a suitable base board.

The engine is capable of making a thousand or twelve hundred revolutions per minute. It must be well balanced for this speed.

The boiler is filled when cold through the safety valve opening by means of a funnel having a slim corrugated tube. The boiler should be about two-thirds full of water at the start.



SIMPLE STEAM ENGINE.

It is obvious a larger engine could be made on the same principle; but the front support for the shaft should be made A-shaped and placed next to the crank, and the cam should be placed between the support and the fly-wheel; the shaft support would then extend over the cylinder-base.

A TOY hoop fell into a conduit at Washington recently and caused a temporary suspension of traffic. The police have prohibited the rolling of hoops in the city on this account.

THE AUTOMOBILE SHOW AT MADISON SQUARE GARDEN, NEW YORK.

The Automobile Club of America is to be congratulated on the success which has attended its first annual show at Madison Square Garden, New York. Although it was regarded as being something of an experiment, the really first-class nature of the exhibits and the excellent attendance stamped this venture as being a thorough success from the very start. The liberal floor space of the Garden was devoted to the groups of automobiles shown by the various exhibitors, and an oval track which had been especially constructed for the purpose was given up to the exhibition of automobiles in motion and to various tests of the starting, stopping and steering qualities of the automobiles. One of these trials was an obstacle race, in which the contestants had to steer their way between barrels and other obstructions which had been distributed over the course. We present an illustration of this race, and also an exhibition of the hill-climbing powers of the steam automobile manufactured by the Mobile Company. Anyone who has doubted the hill-climbing potentialities of these machines would have been greatly impressed with the trial, which was carried out on a specially prepared grade built upon the roof of the Garden. The track, which was carried on trestles, extended with a right-angle turn from the roof of the Garden to the side of the great tower, as shown in our illustration. It was built with three grades of 40, 45 and 35 feet in one hundred, and the whole distance was covered at a speed of from 5 to 8 miles an hour. The feat was performed by an ordinary machine taken from stock, the boiler pressure being about 150 pounds at the start and 145 pounds when the climb was completed. In addition to the exhibit on the main floor of the Garden a large number of machines were shown in the Fourth Avenue end of the building, and also in the Annex at the entrance, while the gallery in the main building was devoted to exhibits of automobile tires, gears, lamps, lubricants, and the various sundries of the automobile trade.

At the entrance to the Garden the first machine to attract attention was one of the massive Panhard & Levassor high-powered machines, which have figured conspicuously in the French automobile races. It is driven by a four-cylindered engine of 24 horse power. It won the Marseilles to Nice race in 1897, and in this country it has won the five mile race for gasoline-driven machines. In a trial on the Guttenburg track it has covered one mile in one minute and 27⅘ seconds. Adjoining this was a steam omnibus with accommodation for twenty passengers, shown by the New York Motor Vehicle Company. The boiler is of the Climax type and is fired with gasoline. The weight is three tons and its 25 horse power engines are capable of driving it at a speed from 8 to 12 miles an hour.

A feature which attracted much attention in the Annex was the historical collection, which made up in interest what it lacked in numbers. It served to emphasize the fact, too little known, that the automobile is by no means a modern invention. Fairly practicable steam carriages were running in England on regular schedule in the early years of the present century, and the machines in this exhibit show that from thirty to forty years ago inventors in the United States were turning their attention to the subject. A decided curiosity was a steam bicycle built by W. W. Austin, of Winthrop, Mass., in 1868. The designer had taken one of the "bone-shakers" of that day and attached a steam boiler and engine to the frame behind the saddle. The machine weighed 90 pounds and had run in its day 2,000 miles upon its iron-shod, wooden wheels. Another historic relic was the steam car built in 1860 by Richard Dudgeon. This machine was a duplicate of the first car built in 1855 and destroyed by fire at the Crystal Palace in London. Although it looked quaint beside the modern machines with which it was surrounded, the workmanship was highly creditable. The card attached to the exhibit stated that it had run 10,000 miles, and that it has been driven at a speed of 35 miles an hour. Another steam bicycle was one built by E. H. Roper, of Roxbury, Mass., in 1896. The weight of this machine is 150 pounds, and it has been run over a third of a mile course in 37 seconds.

A notable machine among the modern automobiles in the Annex which attracted considerable attention was a De Dion racing tricycle, the winner of the Paris-Toulouse race, in which for 836 miles it achieved a speed of 27 miles an hour. The maximum recorded speed of the tricycle for a short distance is 49 miles per hour. Here is also shown the A. A. Riker electric carriage, which won the Blanchet cup, covering 50 miles on the road in 2 hours 3 minutes and 30 seconds. Another historic automobile in the Annex which must be mentioned was the original Duryea gasoline carriage, which in 1895 won The Times-Herald race at Chicago.

A striking feature of the exhibition was the evidence of the increased attention which is being paid to steam as a motive power for automobiles. The

Locomobile Company had a very complete exhibit, conspicuous in which was the locomobile of the type which was illustrated in the SCIENTIFIC AMERICAN of January 27, 1900. This type was shown in a variety of styles, all of which are marked by the clean lines and general light and symmetrical appearance which characterizes machines of this make. The chief innovations this year are the side-steering gear, improvements in the check-valves at the water glass, the enlargement of the oil tank, and the increased weight and strength of the engines. The capacity of oil tank is increased from 3 to 4½ gallons, equivalent to a run of 50 miles, and the water tank can now carry 28 gallons, sufficient for a run of from 25 to 30 miles.

The Mobile Company of America is another concern which has devoted itself with great success to the development of the steam automobile. While the mobile may be called first-cousin to the locomobile, it possesses various distinctive details and wrinkles of the kind which are dear to the heart of the automobilist. It is one of these machines that makes the remarkable exhibition of hill-climbing already referred to. One of the most attractive vehicles shown was the Reading steam carriage, manufactured by the Steam Vehicle Company of America, whose most novel feature is the vertical, four-cylinder 5¾ horse power engine. The four single-acting cylinders are grouped over a common main shaft, to which they are geared in such a way that there is a constant turning movement and a complete balancing of the reciprocating parts. One advantage claimed for this engine is the valve motion, the valve, which is a circular one, rotating continuously in one direction with an even and smooth motion. The boiler is of the upright tubular type with a seamless shell and is tested to 700 pounds water pressure, the working steam pressure being 220 pounds to the square inch.

Another steam carriage is that shown by the Foster Automobile Manufacturing Company, of Rochester, N. Y. Steam is supplied from an upright tubular boiler equipped with a superheater for delivering dry steam to the engine, which is of the two-cylinder reversible type and rated at 6 horse power. The Overman Automobile Company, of New York, exhibited the Victor automobile, a steam-driven machine provided with entirely automatic arrangements for feeding water and fuel from the supply tanks to the boiler and burner. The control of the feed pump is very ingeniously secured by means of an expansion pipe, into which the steam enters should the water fall below a certain level in the boiler, the expansion of the pipe serving to open a valve and direct the water to the boiler. The rising of the water in the boiler shuts off the steam from the expansion pipe and turns the water into the tank, the feed pump being driven continuously from the main axle.

The exhibit of the Electric Vehicle Company was one of the handsomest in the Garden. The incorporators of this company have always been strong advocates of electricity for motive power, and all of the carriages but one in their exhibit were of the electric type. They were all marked by the great beauty and finish which characterizes the work of this company. In the exhibits were the Columbia phaeton, runabout, victoria, rear-boot victoria, cabriolet, surrey, a brougham, hansom, and several others. They also exhibited a gasoline runabout with engines of 4 horse power. The chief advantages of this year's machines manufactured by this company is the substitution of batteries of larger mileage capacity on a single charge.

The American Bicycle Company was represented by a stand on which were shown the Waverley electric vehicles, including road wagons, a runabout, and stanhope; on the same stand were shown the Trimoto, a neatly designed gas-driven tricycle for two people; the Rambler automobile driven by a double cylinder, upright hydrocarbon engine of 4 horse power, and the Cleveland motor tricycle.

The Baker Motor Vehicle Co., of Cleveland, O., exhibited an electric runabout, the distinctive feature of which was the method of carrying the motor, which, instead of being attached to the rear axle, was bolted to the bottom of the car and driven by a chain-drive from the engine to the rear axle. The National Automobile Electric Co., of Indianapolis, Ind., exhibited several electrically-driven carriages.

At the opposite end of the Garden to the Electric Vehicle Company was the extremely handsome exhibit of the Riker Motor Vehicle Company. Although the Riker Company hitherto have used electricity exclusively for operation of their machines, they are now experimenting with gas, and will probably put on the market a gas-driven vehicle for use in the country or where electrical charging stations are not accessible. For city work, or in localities where charging stations are readily accessible, the Riker Company believe that electricity remains, all things considered, the most suitable power. The exhibit of this company included a piano-box runabout, the Riker runabout, a phaeton which was shown in service on the track around the Garden, a victoria, a square front brougham, a station cab, a demi-coach, a theater coach, and a large hotel and station bus capable of accommodating twenty persons. Two other vehicles which attracted much attention were a three-ton emergency wagon and a four-ton truck, which has now been in service for some months in this city.

The Winton Motor Carriage Company exhibited several styles of their well known vehicles. One in particular was a racing machine, splashed with mud and weather-worn, which was driven by Mr. Alexander Winton from Cleveland, Ohio, to Madison Square Garden, 810 miles (November 1 to November 4), at an average speed of 21 miles an hour. The roads during this period happened to be wet and heavy with mud.

Another exhibit of interest was that of the hydrocarbon vehicles by the Haynes-Apperson Company, of Kokomo, Indiana. These are substantially built and easily operated. The first hydrocarbon vehicle built by this company in 1898 was on exhibition in the historical section. The Canda Manufacturing Company exhibited four or five different vehicles, all of which were marked by the neat and compact appearance which distinguishes the Canda machines. One excellent feature of a Canda stanhope which formed part of the exhibit was the method of transmitting power from the engine to the main shaft. This was done by means of two friction disks on the rear axle and a friction spool carried on the engine shaft. The spool was placed between the two disks and in contact with both, giving them a motion in opposite directions. By means of friction clutches either the forward or reverse disk could be thrown into gear. The spool, being movable in a longitudinal direction between the two disks, provides a gear which can be adjusted to an infinite number of variations by means of a lever carried in front of the driver's seat.

OBSTACLE RACE AT THE AUTOMOBILE SHOW.

HILL CLIMBING TEST AT THE AUTOMOBILE SHOW.

The Current Supplement.

The current SUPPLEMENT, No. 1298, contains a large number of articles of unusual interest. The front page illustrates the "Balloons Exhibited at the Vincennes Annex of the Paris Exposition." "Modern System of Teaching Practical Inorganic Chemistry and Its Development" is by Prof. W. H. Perkin, Jr. "The Parallelogram of Motion" is by Prof. C. W. MacCord. "A Case of Total Gastrectomy" gives the history of a most interesting surgical case. "Steam Engineering at the Paris Exposition" is illustrated by sixteen engravings. "Collodio-Chloride Emulsion" is a very full article. "Acetylene and Its Adaptability as a Motive Power to Vehicles" is an important article. "Microphotography as an Aid in Scientific Research," by Dr. Curt Schmidt, is fully illustrated. "Three American Types Deduced from Physical Measurement" is an address delivered at the Psychological Laboratory of Yale University by Prof. J. W. Seaver. "Contemporary Electric Science" gives a number of electric notes. The usual "Trade Notes and Receipts" and "Trade Suggestions from United States Consuls" are also published.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

PLANTER.—JOHN COLBY, Visalia, Cal. The machine is designed to plant corn and other seed. From a drive-shaft the drop-slides of the seed-boxes are operated. A sprocket-wheel is mounted on the axle adjacent to one of the supporting-wheels. To the sprocket-wheel an arm is secured, projecting beyond the periphery of the supporting-wheel. These arms, as the sprocket-wheel rotates, serve as markers, indicating the position of the hills.

RICE DRIER.—LOUIS W. HASKELL, Savannah, Ga. This rice drying and hardening apparatus consists of a chamber having an air-inlet on one side and an air-outlet on the other side. A series of transverse, apertured partitions is provided, the intermediate ones having an air-passage at their alternate ends. Apertured slides are arranged on all the partitions. Several series of reticulated, independent rice-receptacles have rigid tubular heads by which they are suspended from all the partitions save the lowest. Rigid tubular discharge ends are adjacent to the slides. The receptacles are separated to allow free circulation of heated air around them on all sides. Rice dried by this machine is hardened and, therefore, admirably adapted to milling.

PLANTER.—STEPHEN G. SPARROW, Eminence, Ky. The trip mechanism of this apparatus is operated from one of the ground wheels. Checks are provided for the ground-wheels, so placed that checking may be accomplished both ways, dispensing with the check-rowing wire and the "automatic stake-setter." The wheel carrying the checks can be elevated and revolved to register with a row when necessary, and also to provide effective devices under the control of the driver to close the furrow and cover the seed, together with means for separating the seed at the time it is delivered to the furrow.

Electrical Apparatus.

SCREW ELECTRIC CONTACT DEVICE.—CHARLES CHEVALIER, St. Quentin (Aisne), and EUGÈNE CADET, Peronne (Somme), France. The invention relates to a new electric contact device based on the employment of a quick-threaded screw connected with the member or members to be used in effecting the desired end. The device is more particularly applicable to military or other shooting-targets, the shots fired at which are automatically marked at a distance.

METAL-DEPOSITING APPARATUS.—HERMANN R. BOTSFORD, Brooklyn, New York city. At first a comparatively light current is passed into the solution-tank, to prevent a burning-out of the connections for the suspended plates. During the action of the stronger current subsequently employed, agitators are moved up and down, which, by thoroughly stirring the liquid in the tank, breaks up the gases formed on the anode and cathode. By thus destroying the gases, the metal is quickly deposited on the form.

Mechanical Devices.

APPARATUS FOR DYEING SKEIN.—NORBURY L. SMITH, Waterford, N. Y. This invention is an improvement in machines for dyeing yarn in skeins. The machine is of simple construction and has a means for automatically moving the skein into and out of the dye and for causing a rotary movement of the skein while in the dye, thus uniformly dyeing all parts of the material. In order to secure this rotary movement the frame carrying the skeins is driven by gearing, the special arrangement of which constitutes one of the novel features of the patent.

MUSIC-LEAF TURNER.—ROBERT HAMMOND, Caldwell, N. Y. The music-leaf turner is provided with means whereby it can be applied without the aid of screw-clamps or the like and without in the least marring the surface of the part to which such application is made. The mechanism is operated by a touch of the finger. At each touch a sheet-carrying arm is released and a leaf of music turned. Any leaf can be turned back for the purpose of repeating a passage, the reversing mechanism automatically causing the sheet-carrying arm to be locked in initial position until purposely released.

DENTAL-PLUGGER.—ROBERT BLUM, Corpus Christi, Tex. The invention provides an improved dental tool of that class in which the mallet is operated by pulsating or alternately expanding currents of air, as shown in a previous patent secured by the same inventor. The casing of the plugger contains a movable cylinder having connection with the dental tool. A piston-like mallet works within the cylinder so as to strike it and impart movement to the dental tool.

FIRE-ESCAPE.—JAMES O. MILLER and DANIEL AGNEW, Rochester, Ind. The fire-escape has a casing in which a friction-drum is mounted. A flat guide-tube in the casing is adapted to lead the cable to and from the drum. Antifriction rollers are mounted at the upper end of the guide-tube directly adjacent to the drum to press the rope into true engagement with the drum.

STAMP-VENDING MACHINE.—JAMES MACKIRDY, Brooklyn, New York city. The method employed for delivering the stamp is to place the stamps after being sorted, within a box or receptacle, one upon the other. The stamps are removed from the receptacle by means of a suction cylinder provided with a piston inserted within the receptacle until it touches the upper stamp of the pile. The piston is moved upwardly to create a partial vacuum, which will attach the upper stamp to the bottom of the cylinder, whereupon the cylinder is raised and then swung to one side, the stamp being freed by a slight downward movement of the piston.

CANDY-MACHINE.—THOMAS J. JENKINS, Indianapolis, Ind. This invention relates to means for making, forming, spinning, twisting, and cutting stick-candy. The candy batch passes through two hoppers to converging feed-belts. The material is formed by a feeder and sizer and then passes to shaping rollers between guide-plates, and from these rollers through a guide to twisting-rollers.

ACETYLENE-GAS MACHINE.—JOSEPH M. COUGHLAN, Sayville, N. Y. The machine comprises a gasometer and a generator-cylinder arranged side by side. The generator-cylinder passes into a water-vessel with which a segmental lever has connection. A larger segmental lever is connected with the first-named lever and with the gasometer-bell, so that the water-vessel is raised by a lowering of the bell. When the gasometer-bell rises by reason of the gas-pressure, the carbid is out of contact with the water; but when the bell falls, more gas is generated. The action is entirely automatic.

SHINGLE-SAWING MACHINE.—JOHN W. SEAVOLT, Lock 53, Washington County, Md. A work-carrying frame is mounted to swing toward and from the saw; and at one side of the saw a gage is mounted to swing. A shifting-lever has a bifurcated upper end into which a pin on the frame passes. The lower end of the shifting-lever engages a cam-shaft provided with a ratchet-wheel. A pawl is carried by the work-carrying frame to engage the ratchet-wheel. The gage is automatically swung so that the shingles are sawed from the block alternately in opposite directions.

DRILLING-MACHINE.—OLIVER E. OAKES, Joplin, Mo. In a framework a driven shaft carrying a friction-wheel is mounted, together with a bull-wheel. A bearing-post is secured on the frame-work between the bull-wheel and the friction-wheel. Spring-supported friction-rollers are connected with the post. The rollers are actuated to drive the bull-wheel from the friction-wheel. It will be observed that no toothed wheels are used, so that danger of grinding off the teeth of operating-wheels by sudden stoppage is avoided.

Railway Appliances.

AUTOMATIC UNCOUPLING DEVICE FOR DRAW-HEADS.—JOHN T. LEE, Butler, N. J. This device is so constructed and arranged, that before the draw-bar is subjected to breaking or wrecking strain, the attachment will so act that the threatened draw-bar will be immediately uncoupled from its mating bar, the attachment serving also to prevent the draw-bar's dropping to the track, if it be dislodged.

Vehicles and Their Accessories.

WAGON-BODY AND END-GATE THEREFOR.—WILLIAM F. MARQUARDT, Dysart, Iowa. Mr. Marquardt's farm-wagon is designed for hauling grain, grass, seed, and the like, and is provided with an improved means for preventing escape and loss of such substance between the bed or bottom, and the sides and end-board. The wagon-body is provided with a sectional end-gate and right-angular metal guard-strips secured interiorly at the junction of sides and ends with the bottom. The portion attached to the hinged end-gate sections are in two parts or sections, one having a horizontal flange of rhomboidal shape and the other flange being an obtuse-angled quadrilateral.

LOCK FOR VEHICLE-WHEELS.—GEORGE BECKER, Manhattan, New York city. The simple mechanism devised by the inventor can be attached to any vehicle. The mechanism is provided with locking-bars which can be made simultaneously to enter the spaces between spokes in corresponding wheels, thus serving to check a runaway team, to lock the wheels in descending steep hills, or to lock the wheels when the vehicle is to be left standing. The locking mechanism is normally held out of engagement with the wheels.

DRIVING AND SPEED-CHANGING MECHANISM FOR MOTOR-VEHICLES.—LOUIS RENAULT, Paris, France. For each change of speed the inventor interposes two gear-wheels entering into engagement tangentially and not laterally. The mechanism is designed in such a manner that, in changing from one speed to another the gear-wheels of the speed previously employed are rendered inoperative and no longer rotate, thereby obviating friction. Backward travel is obtained by interposing in the mechanism corresponding with the lowest speed, an intermediate bevel-pinion. The speed changing mechanism is controlled by friction-gearing operated by means of a pedal, which also serves to actuate the brake. Change of speed is effected by means of a single hand-lever; backward motion is produced by means of a second pedal. Upon the fly-wheel of the friction-gearing is provided an engaging device without teeth, which is driven by wedging balls within a groove. The engaging device is operated by means of a chain and serves to start the motor, the omission of teeth resulting in a diminution of friction and noise.

BRAKE.—HUGH MAGER, Meadville, Miss. This brake is so constructed that it is out of engagement with the wheels when the vehicle is being drawn ahead, but is immediately placed in position to check the motion of the vehicle the moment the animal or animals are caused to move back or are quickly checked. The action of the brake is automatic to the extent that it is under the control of the draft-animals.

Miscellaneous Inventions.

HORSE-BLANKET.—CHRISTOPHER H. CARLI, Stillwater, Minn. Mr. Carli has devised a means for fastening a blanket in place, so that it will be prevented from being blown off or slipping down around the feet of the animal. The forward end of the blanket has overlapping flaps. Fastening-straps are connected at one end with a surcingle and are adapted to pass over the flaps. Snap-hooks and rings fasten the ends of the straps.

RAILROAD-TICKET.—GEORGE W. CRAIG, Provo City, Utah. This ticket is available for passage between any two of a number of stations, and enables the ticket-agent to make the ticket read via any one of the several lines which lead to the final destination. Hence one form of ticket will suffice where hitherto many forms have been required, thus effecting a considerable saving and affording greater convenience.

CURTAIN-FIXTURE.—CHARLEY B. TITUS and MONTFORD C. MCMAINS, Little River, Kans. The invention is an improvement in curtain-fixtures, and particularly in fixtures which can be attached to the window-sash so that they will raise and lower with the sash. A bracket is employed having an inclined or strut-brace and a top plate bracing the upper end of the strut-brace and provided with a curtain-supporting section having a plate sliding along the strut-brace and arranged at its edges to embrace it.

HOOF-PAD.—MICHAEL HALLAHAN, Manhattan, New York city. With the view of further improving the popular hoof-pads introduced by this inventor, his latest patent shows a new feature for giving additional strength and wearing qualities. The improvement consists in corrugations or other suitable formations on the opposed faces of the rubber cushion and leather backing, so that there is a practical interlock of the two, and all tendency of the cushion to "creep" and become detached is resisted.

PROPELLER-SHAFT BEARING.—JOHN T. SHEPARD, Evansville, Ind. The propeller-shaft is combined with a surrounding tube and springs whereby it is made yielding and spring-seated against longitudinal strain. The construction is designed to prevent wear on the packing.

COMBINATION-TOOL.—WILLIAM E. SEELYE, Brainerd, Minn. This new tool is more especially designed for the use of hunters, explorers, and timber-cruisers. The tool combines a hunting-ax with a knife removable from the ax-handle, so that the knife and the ax can be separately used when desired.

LIFE-PRESERVING FLOAT.—SOLOMON GERMAN, Fork, Baltimore County, Md. The float comprises an inflatable body portion with an opening for a man's waist. A rigid frame, constructed in bow and stern sections is strapped to the body portion. In sockets in the frame, hangers are fitted, which are provided with propellers driven by hand-levers. The life-preserving float is collapsible, so as to be conveniently packed for transportation. When desired, the float can be used in ducking or hunting.

ORE-LEACHING APPARATUS.—JAMES A. FLEMING, Phœnix, Arizona Territory. In leaching ores, the solutions ordinarily employed percolate downwardly through the pulverized ores and carry the gold or other metal out of the ore in solution. The present invention provides improvements in the means for introducing and withdrawing the solution and for compressing the pulp before its discharge.

ORE-LEACHING APPARATUS.—JAMES A. FLEMING, Phœnix, Arizona Territory. This invention seeks to provide means for washing the finished pulp after it passes from the leaching-tank. Broadly, the invention consists of a washing-tank through which the finished pulp, discharged from the leaching-tank, is passed before the final discharge of the pulp. The water in the washing-tank will become a mineralized solution, some of which will come from above with the sifted pulp, and all of which will be compressed from the pulp and thereby saved, as described in the foregoing patent.

SURGICAL APPLIANCE.—CHARLES A. MORENO and JAMES E. BRADY, Portland, Me. The appliance comprises two oppositely-arranged and inwardly-curved rods. Devices connect the ends of the rods, which devices are composed of two parts hinged together and adapted to lock in extended position. A fabric is secured at its side edges to the rods, the fabric being made of such form that it is stretched when the devices are extended.

HOP-DRIER.—ADOLF WOLF, Silverton, Ore. By means of this apparatus green hops can be more quickly dried than has been hitherto possible. The hops are preserved entire and retain their flavor and appearance. The drier saves time, labor, fuel, and expense and preserves the lupulin. At no time are the hops broken; nor need the hops be turned over, as in the ordinary process of drying.

BOTTLE.—JEAN B. TAUVERON, Bath Beach, Brooklyn, New York city. The valve of this non-refillable bottle consists of two balls, one hollow, constituting a float-valve, and the second, solid, constituting a weight to seat the float. An attempt to fill the inverted bottle by means of a vacuum pump will therefore cause the float to rise and close the neck. A novel mouthpiece is provided which is of such construction that a wire cannot be employed to unseat the valve.

PERPETUAL LEDGER.—CHARLES V. HENKEL, Manhattan, New York city. In this ledger two clamping sections are arranged to move toward and from each other and are provided with pins for holding the pages forming the ledger, which pins are made in sections sliding on one another as the clamping sections move. Ledger-leaves are employed which are freely interchangeable, so that a single binder can be used indefinitely by removing the leaves when they are full of accounts.

GUN-BARREL.—WILLIAM S. EVANS, Leechburg, Penn. The bore of the barrel is provided with turns successively increasing in sharpness from the breech to the muzzle. This increase in the sharpness of the pitch, it is claimed, serves greatly to increase the revolution of the projectile in its passage from the breech to the muzzle. The rifling-cuts throughout the bore are parallel. As the barrel has a choke-bore, the rifling is shallow at the breech, but deeper at the muzzle, thus affording a greater hold upon the bullet where the rifling is given the sharpest turns.

CARBURETING-LAMP.—JOSEPH C. PEDEN, New Albany, Ind. A vapor-pipe has communication with the burner. Above the burner a heating-tube is arranged, supported on the burner-chimney. An air-drum, receiving heat from the heating-tube, has communication with the vapor-pipe. A spreader, supplied with gasolene, extends down in the vapor-pipe. The feed of gasolene is automatically controlled, so that after once igniting the gas in the burner no further attention need be paid to the lamp.

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PLATE FOR FOOD-BOILERS.—NELLIE J. KELLY, Victor, N. C. The plate is to be placed in the bottom of a pot for preventing food, except cereals and starch, from scorching when being boiled.

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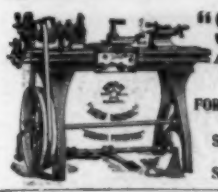

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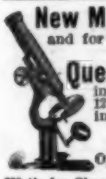

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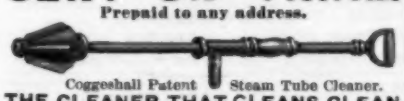

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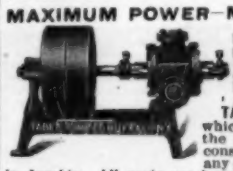

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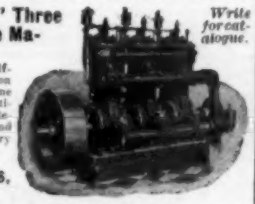

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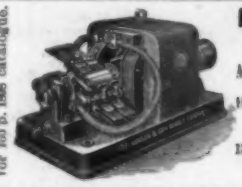

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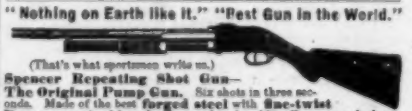

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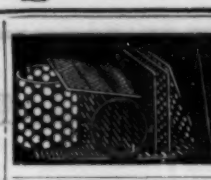

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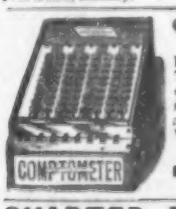

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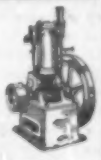

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